

**CHARLES RIVER STUDY**

*Summary of the Sixth Meeting of the  
Coordinating Committee  
for the  
Charles River Study  
at  
Waltham, Mass.*

*5 March 1969*

**Prepared by**

**Department of the Army**

**New England Division, Corps of Engineers**

**424 Trapelo Road, Waltham, Mass.**

# SUMMARY OF THE SIXTH MEETING OF THE COORDINATING COMMITTEE

## CHARLES RIVER WATERSHED STUDY

5 March 1969

1. The sixth meeting of the Coordinating Committee was held in the Library, New England Division, Corps of Engineers, Waltham, Massachusetts. Attached as Appendix A is a copy of the agenda. The following members and guests attended this meeting:

### 2. COORDINATING COMMITTEE MEMBERS OR ALTERNATES

#### a. Federal Agencies

U.S. Army, Corps of Engineers, Colonel Franklin R. Day,  
Acting Committee Chairman

U.S. Department of Agriculture, Mr. Karl Klingelhofer,  
Massachusetts Soil Conservation Engineer

U.S. Department of Health, Education and Welfare, Mr.  
Floyd B. Taylor, Public Health Service

U.S. Department of Housing and Urban Development, Mr.  
Frank A. Batstone, Deputy Director of Planning, Program  
Coordination and Services Division, Region I

U.S. Department of Interior, Mr. Bart Hague, Federal  
Water Pollution Control Administration

#### b. State Agencies

Massachusetts Department of Natural Resources, Mr.  
Evans C. Hawes, Director, Conservation Services

Metropolitan District Commission, Mr. Allen Grieve, Jr.,  
Director of Water Division

Metropolitan Area Planning Council, Mr. William Firth,  
Landscape Architect - City Planner

### 3. GUESTS

#### U. S. Department of Army, OCE

Mr. Irwin Reisler, Asst. Chief, Planning Division, Civil Works  
Mr. John R. Hadd, Asst. Chief, Policy and Analysis Division,  
Civil Works

#### U. S. Department of Interior

Mr. William Butler, Sanitary Engineer, FWPCA  
Mr. Eugene Walker, U. S. Geological Survey  
Mr. Norrel Wallace, Fish and Wildlife Service

#### Massachusetts Department of Natural Resources

Mr. John Blackwell, Urban Planner, Conservation Services Division  
Mr. Thomas F. Doucette, Civil Engineer, Water Resources Commission, Division of Water Pollution Control  
Mr. Alfred F. Ferullo, Env./Biol. Engineer, Division of Water Pollution Control  
Mr. Matthew B. Connolly, Jr., Div. of Fisheries and Game  
Mr. Richard Cronin, Fisheries Biologist, Div. of Fisheries and Game  
Mr. Joseph S. DiCarlo, Marine Biologist, Div. of Marine Fisheries  
Mr. Kenneth E. Reback, Marine Biologist, Div. of Marine Fisheries

#### Metropolitan District Commission

Mr. Max H. Straw, Admin. Engineering Assistant  
Mr. Joseph Capone, Jr., Civil Engineer, Construction Div.

#### New England Division, Corps of Engineers

Mr. Edward L. Hill, Chief, Planning Branch  
Mr. Joseph L. Ignazio, Chief, River Basin Studies Section  
Mr. John M. Lind, Project Engineer, Charles River Study  
Mr. Arthur F. Doyle, Engineer, Charles River Study  
Mr. John J. Caffrey, Engineer, Charles River Study  
Mr. Lewis A. Carter, Recreation Specialist, Planning Branch  
Mr. Elliot Childs, Chief, Hydrology & Hydraulics Branch  
Mr. Oscar L. Donati, Hydrologist, Hydrology & Hydraulics Br.  
Mr. Clarence N. Morang, Hydrologist, Hydrology & Hydraulics Branch

Citizen Advisory Committee

Mrs. Talbot Baker, Millis  
Miss Roberta T. Chesnut, Pres. Fenway Civic Assn.  
Mr. Henry J. Colombo, Wilmington  
Mrs. H. Shippen Goodhue, Wellesley  
Mr. John Plimpton, Sherborn  
Mr. Kenneth H. Wood, Westwood

New England River Basins Commission

Mr. Michael H. Farny, Administrator

Others

Mr. John Greco, Millis Planning Board

PROCEEDINGS

The Coordinating Committee was convened by the Acting Chairman, Colonel Franklin R. Day, who introduced the committee members in attendance. Col. Day then turned the chair over to Edward L. Hill, Chief of the Planning Branch. The proceedings of this meeting are summarized below. The complete texts of the formal presentations are attached as appendices.

STUDY PROGRESS

Col. Day opened the meeting with a brief status report and statement on the purpose of the meeting. (See Appendix B).

CONSIDERED IMPOUNDMENTS

a. Mr. Caffrey reviewed the status of the SCS potential water storage impoundment sites and told of local discussion meetings which have been held.

b. Mr. Doyle introduced the Corps of Engineers main stem and diversion plans now under consideration. (See Appendix C).

OPEN SPACE AND POPULATION

Mr. John Blackwell covered population projects in the watershed communities through the year 2020. He stressed the need for early acquisition of land for open space, particularly in the upper Charles where there is opportunity. (See Appendix D).

Upon questioning by Mr. Lind, Mr. Blackwell expressed the opinion that the projected population figures would be little affected by land acquisition for open space. Extensive reservation of open spaces would tend to affect the type of housing - less single homes and more multiple story structures would be built to meet the demands.

Mr. Batstone, HUD, commented that priority for land acquisition will go to projects which are part of a plan.

Mr. Straw expressed concern as to the value of population as a safe tool and suggested that a sampling of people in any area of downtown Boston would show that many are commuters not living in Boston.

## CHARLES RIVER HYDROLOGY

Mr. Childs covered the low flow and flood problems in the Charles using the 1961-66 dry period and the March 1968 flood for examples. He indicated that retention of natural storage is important in prevention of future flooding and may well be an important element in a watershed plan. (See Appendix E).

## DOMESTIC WATER SUPPLY

Mr. Ignazio read a paper prepared by Paul Pronovost (See Appendix F) on the NEWS study.

Mr. Hill commented on "Water Mining." Water supply taken from the Charles, then discharged to Boston Harbor through MDC sewerage systems depletes Charles River water.

A question was raised on diversion of one-third of Charles River flows to the Neponset by way of Mother Brook. Some discussion ensued. The subject of diversion during the entire range of flows will be explored in the near future.

## STREAM CLASSIFICATION AND WATER QUALITY IMPROVEMENT

Mr. Ferullo, DNR, covered the subject of Stream Classification and sources of pollution and activities in the field of pollution abatement. The need in the future of costly removal of nutrients was mentioned.

In answer to a question, Mr. Ferullo stated that nutrients removed would have little value.

Mr. Straw described proposed operation of the storage chamber near B.U. Bridge.

Mrs. Baker, of Millis, asked about pollution by Cliquot Club. Mr. Ferullo stated that the Rubberoid pollution was being taken care of but that Cliquot is a gross polluter - principally nutrients from washing equipment and bottles. (See Appendix G).

## POLLUTION AND SEWAGE

Mr. Butler, FWPCA, presented, with slides and tables, projected populations and pollution loads to be handled by treatment and low flow augmentation. He showed examples of economics involved in determining the use of treatment and low flow augmentation. (See Appendix H).

## AFTERNOON SESSION

The afternoon session was devoted principally to discussion of open space recreation and fish and wildlife in the Charles River watershed.

Mr. Lind opened with brief discussion of elements of a plan. Mr. Childs has demonstrated that retention of natural valley storage principally along the Charles upstream of South Natick is necessary to prevent larger floods in the future. Retention of natural valley storage would also afford fish and wildlife benefits and recreation benefits. Some indication of these benefits is needed.

Messrs. Hadd and Reisler, OCE, commented on the satisfactory progress being made on the study.

Mr. Norrel Wallace, representing the U.S. Fish and Wildlife Service, spoke on the hunting and fishing needs of the watershed population. He stated the present demand as 550,000 fishing days and 300,000 hunting days for the population. For the year 2000, he forecasts a fishing demand of 2,000,000 fishing days and 400,000 hunting days per year. Some of this demand could be met by creation of new impoundments in the Charles and reservation and use of lowlands for wildlife. Mr. Wallace quoted a benefit figure of 15¢ per day use for reserving areas for migrant water fowl. He was also of the opinion that six new fish ladders should be installed at existing dams for alewives and shad.

Richard Cronin, Massachusetts Fish and Game Division biologist spoke of the plan for study of the Charles this year. Mr. DeCarlo, Division of Marine Fisheries will work from the ocean upstream, Fish and Game, downstream.

Matthew Connolly, Massachusetts Fish and Game Division stated that the Charles has an unjustified bad image in terms of fisheries resources. The pollution is not as bad as often described. He mentioned the Division's program to instruct disadvantaged children of the inner core of Boston in fishing and becoming accustomed to the outdoors.

Mr. DeCarlo said that seasonally there are smelt and alewives in the lower Charles. He feels there are good spawning beds as far upstream as South Natick and possibly to Medway.

In regard to fish ladder construction they are usually incorporated in dams as they are constructed. Mr. DeCarlo did not offer a solution to the cost of installing fishways in existing dams.

Mr. Lewis Carter, Corps of Engineers, said that statements of many today indicate the great difficulties besetting public agencies, including Federal, State and town, in buying critical open spaces before they are grabbed by private interests. The fact that government cannot put cash on the barrelhead is one which was treated in a different manner in the Potomac River Study. A blue ribbon panel in this study recommended a common acquisition fund derived from such public agencies as the Department of Interior, Corps of Engineers, Ford Foundation, Nature Conservancy, etc. This fund would be available in a bank account for instant use if needed. Suggest that the members of the Committee look at this Potomac River study since it has parallels to the Charles River.

This scheme was spoken of later by Mr. Hague of the Department of Interior who also suggested another scheme of preventing open spaces from unwise use. He cited the legislation establishing an area as specifying the boundaries within which no further alteration would be permitted. In the case of the Redwood National Park, for one, this prevented the owners of redwood property from any further cutting, even though the Federal government was not buying the land at the present time. This puts an effective freeze on critical areas.

Mr. Hague, Interior, stated also that the Charles River area was certainly an important area under the Massachusetts State Recreation Plan.

Evans Hawes, DNR, said the present 1966 State Recreation Plan is the one under which the state was operating. It is now being updated by Mr. Blackwell. He also said that the Charles River is an area which would be considered by the DNR as a priority part of the State plan.

Mr. Hawes was asked by Mr. Lind - is the new inland wetlands bill effective? He replied that it does not, at this stage, protect any particular piece of wetland, but is ready to go. He believes it will be effective. In the meantime, wetlands receive a measure of protection from the Hatch Act.

Mr. Cronin related that the Division had bought about nine miles of a river, but that their worry is any action which might choke off a tributary.

Mr. Blackwell inquired from Mr. Firth, MAPC, about the availability of the plan for the report on the Charles, Mystic and Neponset Rivers. He replied that the draft had been completed last December, approved by the Council, and that it should be ready in six weeks. He also said that Julia O'Brien is in charge of this.

Mr. Hill, Corps of Engineers, summarized the meeting. He expressed thanks to the representatives of local communities who have participated and have come. It is what is needed and very important. The many elements in this study can now be observed as being unable to stand alone, but they are interdependent. The Charles River as a whole must include all these elements.

MEETING ADJOURNED AT 2:30 PM.

# CHARLES RIVER STUDY AGENDA

Wednesday, 5 March 1969, Sixth Coordinating Committee Meeting  
New England Division, Corps of Engineers, 424 Trapelo Rd., Waltham, Mass.

9:00 A.M.	REGISTRATION	
9:15	Opening Remarks	Col. Frank P. Bane, Div Engr, NED
9:30	Water Impoundment Sites Being Considered	John J. Caffrey, Tributaries Arthur F. Doyle, Main River
	DISCUSSION	
10:00	Open Space & Population	John Blackwell, Urban Planner
10:20	DISCUSSION	
10:30	Charles River Hydrology	Elliot Childs, Chief, Hydrol. Br.
10:50	DISCUSSION	
11:00	Domestic Water Supply	Paul Pronovost, Chief, Northeast Water Supply Study Unit, NED
11:20	DISCUSSION	
11:30	Stream Classification and Water Quality Improvement	Alfred F. Ferullo, Mass. DNR, Water Pollution Control Division
11:50	DISCUSSION	
12:00 Noon	Pollution & Sewerage: Treatment Studies	William Butler, Federal Water Pollution Control Admin., USDI
12:20	DISCUSSION	
12:30	LUNCH	
1:05	Re-convene: Call to order	Colonel Bane
1:10	Wetland Elements of a Charles River Plan	John M. Lind, Project Engr., Charles River Study, NED
1:30	DISCUSSION	
1:40	Fish & Wildlife Enhancement	U.S. Fish & Wildlife Service, Dept. of the Interior
2:00	DISCUSSION	
2:10	State & Federal Aids for a Charles River Plan	U.S. Bureau of Outdoor Recreation, Dept. of the Interior
2:30	DISCUSSION	
2:40	Summary and Closing Remarks	Colonel Bane
3:00	ADJOURNMENT	

APPENDIX B  
PRESENTATION

by

COLONEL FRANKLIN R. DAY

5 March 1969

Coordinating Committee Meeting

CHARLES RIVER STUDY  
SIXTH COORDINATING COMMITTEE MEETING

5 MARCH 1969

PRESIDING OFFICER

OPENING REMARKS

This is the sixth meeting of the Charles River Study Coordinating Committee. My name is Franklin R. Day and I am Deputy Division Engineer, New England Division, Corps of Engineers, U. S. Army. Poor health has prevented the Division Engineer, Colonel Frank P. Bane from attending this meeting today and he asked that I express his personal regrets to each of you that he is unable to attend.

For the benefit of our guests, I ask each Committee Member (or alternate) present to rise, and give his name and title, as I call upon his agency:

- U. S. Department of Agriculture
- U. S. Department of Commerce
- U. S. Department of Health Education & Welfare
- U. S. Department of Housing & Urban Development
- U. S. Department of the Interior
- Mass. Department of Natural Resources
- Mass. Metropolitan District Commission
- Mass. Metropolitan Area Planning Council

Will Corps of Engineers staff members please rise and give their names and titles:

Will Citizen Advisory Committee members please rise and give their names:

Our focus today is on environmental preservation, with emphasis on open space actions throughout the Charles River Study Area.

We are starting to close in on a Charles River Watershed Development Plan for the main river, and tributary streams, lakes, and ponds and related land resources. The major problems and needs in water supply, sewerage, water quality, flooding, fish and wildlife, and open space are quite well in view. So are the major directions of solution or improvement.

Our study progress and procedure are generally following the August 1967 Plan of Survey outline and we are well on schedule. I will mention briefly seven facets of our current progress.

1. The North Atlantic Water Resources study and the Northeastern U.S. Water Supply Study together are establishing a regional framework inventory of surface-water and ground-water resources within which to view Charles River municipal needs and resources. Already, the ever enlarging water demands of middle and upper Charles population growth are pressing hard

against water supply resources available to areas in the Charles not now served by the Metropolitan District Commission.

2. The Federal Water Pollution Control Administration is conducting a Water Quality Management Study of Boston Harbor, Massachusetts. Charles River waters have been observed and sampled at 17 stations. Sixteen upper Charles sources of pollution, Milford to Dover, were identified in a September 1968 FWPCA report to the Fifth Coordinating Committee meeting here at Waltham.

3. The U. S. Soil Conservation Service reported to the September 1968 meeting on 45 potential upper Charles water impoundment sites on tributary streams and two on the main river. These sites are now being evaluated in local discussion meetings and interagency conferences.

4. The Corps of Engineers, New England Division, has studied flood problems on the entire river. Our 29 May 1968 interim recommendations for improving flood control in the Lower Charles were congressionally authorized on 13 August 1968. Flooding in the middle and upper Charles is an almost annual spring freshet experience which produces scattered inconvenience and occasional damage in lowlands. However, prospective Charles River population growth and resulting building development could soon create much larger flooding problems -- problems that can be

reduced by timely, low cost community actions to keep existing wetlands and related uplands open.

5. The New England Division, with the assent of the Metropolitan District Commission, M.A.P.C., Mass. Department of Natural Resources, U.S. Dept. of Housing and Urban Development, and U. S. Department of the Interior, is preparing a Charles River open space study memo with recommendations for implementation by the respective open-space action agencies. These recommendations will be integrated with Charles River water resource and water quality improvement recommendations of participating agencies.
6. The New England Division is examining re-use and storage improvement possibilities at existing ponds on and close to the Charles, and at other locations on the Charles including existing dams on the main river. Unevaluated potentials have been noted at Echo Lake, Louisa Lake, Beaver Pond (Bellingham), Beaver Ponds (Franklin), and South End Pond, Millis. The re-use of City of Cambridge Stony Brook Reservoir and Hobbs Brook Reservoir was extensively examined and briefly reported to the September 1967 Coordinating Committee meeting.
7. The New England Division fish and wildlife biologist in 1968 examined and reported on enhancement potentials for fishing and

wildlife in the middle and upper Charles. Exchange of views was maintained with biologists of the U. S. Fish and Wildlife Service and of the Mass. Fish and Game Division. Water level management regulation rule curves for Charles River Valley impoundments with fish and wildlife enhancement potentials have been written in draft form, but are not yet ready for circulation.

Thus the stage is set for pulling a variety of Charles River study elements together. As Chair Agency, that will be our effort in calendar year 1969. Following interagency adjustments, a draft report will be circulated to Coordinating Committee members for review and approval, hopefully by the end of 1969.

As much as I would like to remain with you today, the press of problems in connection with the record snowfall which presents a potentially dangerous flood hazard dictates that I leave this meeting. We are actively engaged in problem definition and coordination with a number of Federal, State and local agencies in an attempt to minimize damage if and when flooding actually occurs here in New England. I hope that each of you appreciates the need for such timely action and will excuse me from further participation here today.

In my absence, Mr. Edward L. Hill, Chief of our Planning Branch will assume the role of temporary chairman.

APPENDIX C  
PRESENTATION

by

JOHN J. CAFFREY  
ARTHUR F. DOYLE

5 March 1969

Coordinating Committee Meeting

CHARLES RIVER STUDY

COORDINATING COMMITTEE MEETING

5 March 1969

TRIBUTARY STREAM SITES

by

John J. Caffrey  
Corps of Engineers  
Department of the Army

Plate 1 shows fifty potential impoundment sites upstream of South Natick Dam. Forty-six of these sites (shown in green) were reported by the Soil Conservation Service to the Coordinating Committee last September. The SCS interim technical report with maps and tables of these sites was mailed last December to each Coordinating Committee Member, to Citizen Advisory Committee Members, and to the Selectment, Planning Board and Conservation Commission of each of the middle and upper Charles towns.

Local discussion meetings with municipal officials and Citizen Committee Members on these sites and other topics have been held as follows: 21 November 1968 with Norfolk (County) Conservation District, at Walpole; 4 December 1968 with Middlesex (County) Conservation District at Sherborn; 13 January 1969 with Wellesley and Needham, at Wellesley; and 4 February 1969 at Norfolk with Medfield, Millis, Norfolk, Walpole & Wrentham. Our purpose has been to learn the local needs and desires and reactions to these sites as they bear on our water, Wetlands and Open Space Study memo.

Some 45 potential impoundment sites on Charles River tributaries have been inventoried. Upon screening and development of a basin plan, it is anticipated that some of these sites will be eliminated from further consideration.

Water supply use of any impoundment site in practice becomes an exclusive use of that site and the surrounding area. In the Charles, every up-river municipality is going to need all the local pure water it can hold onto, unless or until water from non-local sources can be imported into the town or into the region.

Low-flow augmentation use of any impoundment site can be compatible with other uses of the water at the impounded site, such as swimming, boating, fishing, and some kinds of wildlife enhancement.

For low-flow augmentation itself, there are two physical factors familiar to most of you: first, the farther up-stream the low-flow water is put in, the more river miles are "sweetened" thereby; second, the farther upstream, the more important the effect of a modest water input. Accordingly, our impoundment searches and evaluations have been pressed hardest in the Upper Charles from Populatic Pond to Echo Lake.

CHARLES RIVER STUDY

## COORDINATING COMMITTEE MEETING

5 March 1969

## STRUCTURAL METHODS

by

Arthur F. Doyle  
Corps of Engineers  
Department of the Army

My remarks this morning will pertain to the structural methods and plans being considered for the Upper Charles River area.

Flood damage within the upstream area of the Charles River is minimum and therefore little need for a single-purpose flood control dam. Instead, primary concern was given to low-flow augmentation, recreation, fish and wildlife, aesthetics and incidental flood control benefits.

Five structural methods were considered and they are as follows:

- (1) Diversion from outside the Charles
- (2) Diversion within the Charles
- (3) Redevelopment of existing dams
- (4) Diversion of Bogastow Brook
- (5) Bridge openings across Charles and new Route 109

DIVERSION FROM OUTSIDE CHARLES RIVER

A small 4 sq. mi. addition to the Charles River headwaters drainage area may be accomplished in Hopkinton. The water presently flows to the Merrimack River via the Ashland Reservoir and Sudbury River. The Ashland Reservoir is under the jurisdiction of the Mass. Department of Natural Resources. However, water is presently diverted from the Sudbury drainage area through the Sudbury River Aqueduct to the Charles River in Newton Upper Falls at river mile 20.0. Diversion could be accomplished by providing closure south of the pond at North Mill Street thereby enlarging Blood Pond and constructing a new channel to the vicinity of the intersection of Prentice and Marshall Streets in Holliston. Water would then flow to through Cedar Swamp, Holliston, and Hopping Brook to the Charles River just downstream of the Caryville Dam in Bellingham.

Release from this impoundment at Bloods Pond would provide low flow for over 6 miles of Hopping Brook and enter the Charles River at river mile 64.4. Such a diversion would require agreement with DNR and MDC

since the 4.1 s.m. is more than half of the drainage area of Ashland Reservoir. However, if this diverted water were used for low-flow augmentation, diversion to the Charles through the Sudbury Aqueduct, up to 19 mgd per day when needed, may not be necessary during extreme dry periods.

Another diversion could be made to the Charles from North Pond in Hopkinton. Spring freshets could be diverted by construction of an intake near the existing dam and piped southeasterly beyond the divide to the Soil Conservation Service impoundment site number 904 above Silver Hill St. in Milford. Only snowmelt, spring freshets, or flood flows would be diverted. Runoff during summer would follow its normal course down Mill River to Hopedale Pond.

### DIVERSION WITHIN CHARLES

This method considers storing spring freshets of the Charles River at a remote sub-impoundment within the Charles River watershed. Very few opportunities were found. The best site appears to be at Beaver Pond, Bellingham. The location is good-being located in the upstream reach at river mile 73. The shores of the pond are not heavily populated and therefore real estate and relocations should be relatively inexpensive. Filling the reservoir with spring freshets may be accomplished in one of two ways, either by gravity diversion or pumping. Gravity diversion would be accomplished by providing an intake structure in Cedar Swamp Pond, Milford and diverting water southerly through the divide between Beaver and Maple Street to Beaver Pond. Filling Beaver Pond by pumping would require a small pumping station constructed on the Charles River upstream of the Milford Sewage Disposal Plant. Pumped waters would then flow easterly beyond the divide to Beaver Pond. The outlet for Beaver Pond for either method would be changed to the west, discharging downstream of the Milford Sewage Disposal Plant. The plan envisioned would provide benefit from low-flow augmentation, recreation, fish and wildlife and flood control.

### REDEVELOPMENT

Redevelopment of an existing dam has many advantages over developing a new site on the Charles River main stem. Advantages generally attributed to redevelopment are: little additional land is required, the and adjacent areas can generally be purchased for little cost to relieve the owners of their riparian liability. Also, the public is used to seeing water impounded at a certain location and therefore opposition for an impoundment should be slight.

Of the many dams located on the Charles from the South Natick Dam upstream to Echo Lake Dam the redevelopment of North Bellingham Dam and Echo Lake Dam are considered to be the most feasible.

The crest elevation of the North Bellingham Dam is 203 msl, and with no outlet, the pool elevation is also 203 msl. It is assumed the depth of water behind the dam is only 3 or 4 feet. The area upstream of the dam consists of a small 12-acre pool within a 400 acre swamp and marshland. For about 2 miles upstream of the dam, elevation 205 is not exceeded. The land beyond this wet basin rises rather quickly to the 220, 230 contours. Inundation occurs to elevation 208 during floods similar to the March 1968 flood. The land and relocation costs below elevation 210 should be small, especially considering the majority of the land is in the flood plain. The plan envisioned would provide for low-flow augmentation, recreation, fish and wildlife and flood control. Architect-Engineer studies for the Milford Water Company have proposed increasing the drainage area of Echo Lake and increasing the storage by increasing the height of the dam. Both plans are concurred with.

#### DIVERSION OF BOGASTOW

The largest tributary drainage area to the Charles is the Bogastow Brook with a drainage area of 25.5 square miles. No practical large reservoir sites are considered for this tributary but with little work, waters may be diverted to the Charles at river mile 60 rather than mile 48.5 thereby providing the Charles with 12 additional miles of increased streamflow. To accomplish this, provide a small closure south of Orchard Street thereby backing water into the Great Black Swamp to the Millis-Medway town line. By excavating a small ditch in the swamp in the area between the town line and railroad, the waters of the Bogastow would flow southerly entering the Charles upstream of Populatic Pond.

#### BRIDGES ACROSS RIVERS AND RELOCATION OF ROUTE 109

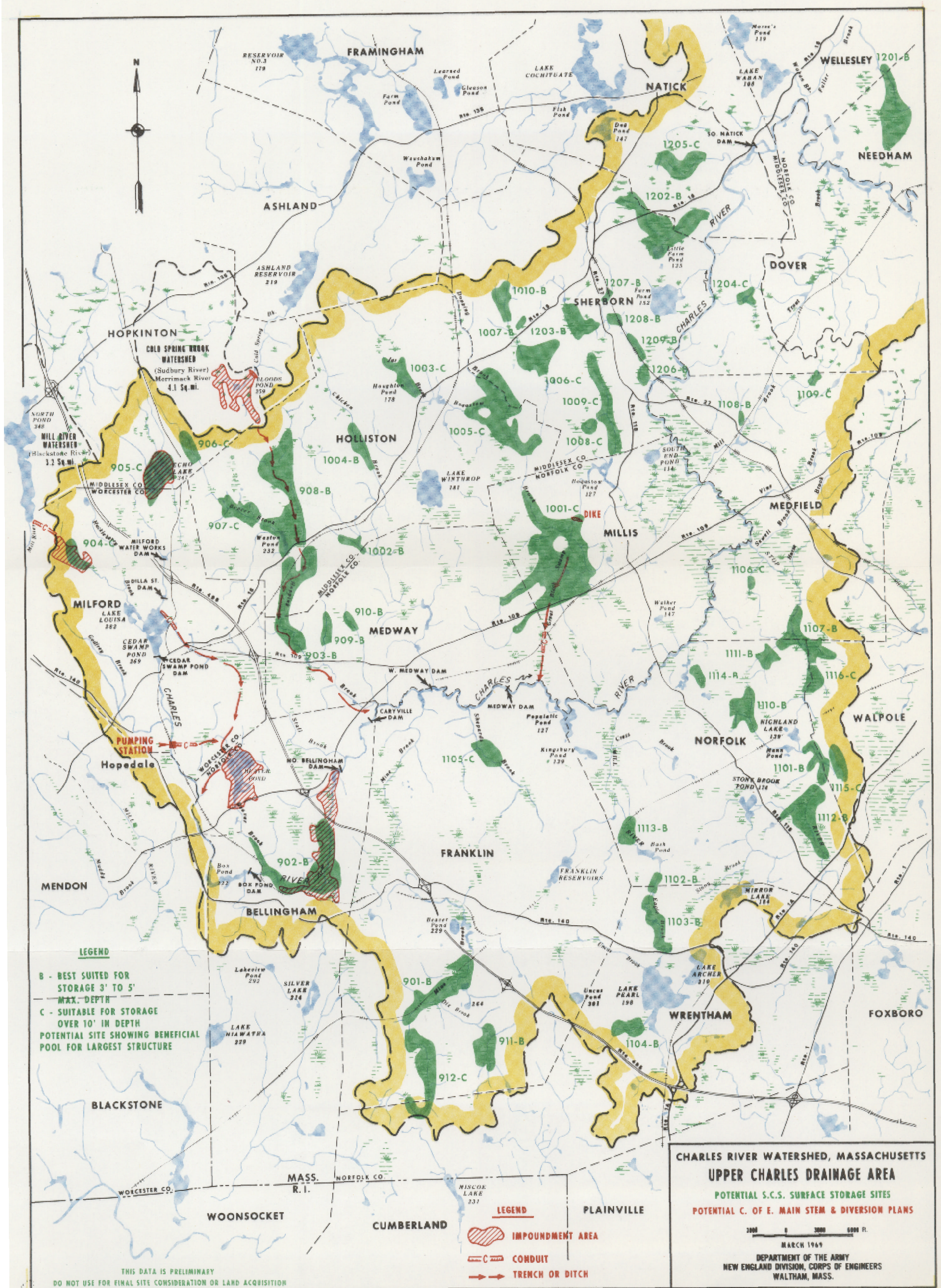
No specific bridge opening is being considered at this time. However, when bridges are to be replaced or modified, they should be examined for their flow capacity. In some cases, it may be wise to restrict the opening thereby detaining potential flood waters. Currently being studied is the Route 109 relocation and indications are the new route will be parallel and north of the existing 109. This relocation will cross several of the major tributaries as well as the Charles River. Many opportunities will present themselves for dual-purpose projects, i. e. transportation and water resources. However, they should be designed for multiple use. There is a considerable difference between road fill which random material dumped and a dam embankment which is selected material placed in thin layers and compacted. The purpose must be considered in the planning stages.

## SUMMARIZING

There are many structural possibilities in the Charles River watershed:

- SCS Impoundments
- Diversions
- Redevelopment
- Multiple-Use Planning

All of which can meet two or more needs: Low-flow augmentation, Recreation, Fish and Wildlife, Aesthetics and incidental flood control benefits.



APPENDIX D  
PRESENTATION

by

JOHN BLACKWELL

5 March 1969

Coordinating Committee Meeting

REMARKS TO THE SIXTH  
CHARLES RIVER STUDY  
COORDINATION COMMITTEE MEETING  
5 March 1969 by Mr. Blackwell

OPEN SPACE AND POPULATION

Physical and economic factors determine the water storage potential locations mentioned by Mr. Caffrey and Mr. Doyle.

Those factors likewise determine wetland and open space reservation possibilities along the Charles and its tributaries.

The potential water impoundment sites can also be starting points for an open space reservation network. There could be obvious need to reserve selected upland area -- bordering or giving access to actual impoundments. Even the shallowest impoundments may enhance fish and wildlife potentials and coordinate with local conservation needs and plans.

In the Charles River Valley there is only the one given land area for all uses: urban and non-urban; water spaces; wetlands; and uplands. For our study purposes, this total area is unchangeable. There can be small physiographic alterations by ditching, diking or filling, but the Charles River total drainage area cannot physically be much enlarged or contracted.

The population and urban development of the Charles are so obviously increasing and intensifying that it can be said there is great need for an over-all open space plan, especially for the middle and upper Charles. Urban growth is increasing throughout the United States east coast. There is need to preserve basic liveability, water supply capability, recreation capability and sewage disposal opportunities in the Charles River study area by some open space plan.

The afternoon of the September 1968 Coordinating Committee Meeting, it became established in a round-table discussion that the Corps of Engineers, New England Division, as Chair Agency, would prepare an Open Space Study Memo with data inputs from other agencies.

A resulting town-by-town inventory of existing public and semi-public lands has been compiled from municipal assessors records, from Federally aided town plan reports, from State agency reports including MDC, MDNR and MAPC, and from field checks and aerial photograph checks of questioned items.

An inventory of existing major non-urban land uses by upland and lowland has been compiled town-by-town from our public lands inventory, from the U. S. Department of Agriculture Soil Conservation Service findings, and from available March 1968 wetted areas and high-waters information.

The Metropolitan Area Planning Council staff made their maps available, also their landscape and land form visual character survey in parts of the Charles Study Area, and their draft of an Open Space Plan for the Boston metropolitan area which was released in October 1968 by vote of the MAPC members in council assembled at Waltham. In addition, the historic sites and buildings inventories, town-by-town, of the Massachusetts Historical Commission are accessible.

An Open Space Plan for the Charles is being prepared with easement and acquisition recommendations to be carried out by the towns and the Corps of Engineers as to main stream impoundments, and by the towns and cities with other State and Federal agencies as to all other wetlands and open space actions.

While open space opportunities are physically limited, population growth and urban growth are virtually uninhibited. In time, the whole Charles River Valley could be wholly built over, as, in 340 years, the lower Charles has already become. We need to remind ourselves that only 100 years ago the lower Charles study area was more open, more green, more "unspoiled" than the middle and upper Charles areas of the 1960's and 1970's.

The lower Charles resident population a century ago was about 168,000 persons. This was 81% of the total Charles River Valley 1865 population. Also the 168,500 was only two-thirds in number of persons the resident population of the middle and upper Charles today, which was about 253,800 in 1965. The 340 year urban growth history of the whole Charles and of the Lower Charles study area was summarized in the May 1968 Lower Charles Interim Report on Flood Control and Navigation, published by the New England Division of the Corps of Engineers.

A tentative population projection averaging 50% growth for the whole Charles River Valley in three geographic segments by the year 2000 was published in that Lower Charles Interim Report, Appendix B, Table B-7, page B-19. This projection was first reported to the February 1968 Coordinating Committee Meeting.

Then and in the months intervening, population projections by others for various portions of the eastern United States have been examined and relevant factors noted. Also the U. S. Department of Commerce, Office

of Business Economics, prepared a 230-county population and employment projection for the Washington Office of the Chief of Engineers, Corps of Engineers, revising their June 1967 Appendix B (Economic Base) report to the North Atlantic Regional Water Resources Study Coordinating Committee.

In December 1968, adhering to OBE geographic sector control totals, the Regional Plan Association, Inc., delivered to the Chief's Office a modified range of population projections for the N. A. R., within which the Northeastern Water Resources Study and the Charles River Study population projections must fit. Accordingly, a more detailed population projection for the whole of each Charles River municipality twenty percent (10%) or more by area within the watershed has been prepared from a 1960 base town-by-town, and is shown in Table No. 1.

In manuscript only, there is an individual write-up for each town, reciting the principal factors determining the projection selected for that town from the four computer-runs made the summer of 1968 for the Charles River Study towns and cities. The methodology is summarized in the two pages of notes following the table.

A computer program was developed for Charles River Study population projections which will accept both the historical and the forecast population numbers, will perform a least squares analysis to determine the equation of the line of best fit, and then, using this equation, determine a future population for any period of years desired. In this program each of the input

data may be weighted differently. More weight may be given to recent years and the weight on earlier years or on forecast data may be discounted. Population forecasts obtained by this method plus those from NEWS and MAPC together broadly define a reasonable range of future populations.

TABLE NO. 1

## CHARLES RIVER STUDY

NED Population Projections  
 Entire Municipality where 10% of town total area or  
 more is in the Watershed

<u>Municipality</u>	<u>1960*</u>	<u>1980</u>	<u>2000</u>	<u>2020</u>
Bellingham	6,775	14,400	20,200	26,000
Belmont	28,715	30,500	34,500	40,000
Boston	697,195	700,000	725,000	750,000
Brookline	54,045	56,900	62,000	67,000
Cambridge	107,715	95,000	105,000	110,000
Dedham	23,870	28,500	34,400	40,000
Dover	2,845	5,400	7,500	10,000
Franklin	10,530	17,500	22,000	30,000
Holliston	6,220	11,000	15,000	20,000
Hopedale	3,985	5,000	7,500	10,000
Hopkinton	4,930	8,000	12,000	17,500
Lexington	27,690	35,000	40,000	45,000
Lincoln	5,615	8,000	11,000	15,000
Medfield	6,020	9,000	12,000	15,000
Medway	5,170	10,000	15,000	20,000
Milford	15,750	20,000	24,000	27,500
Millis	4,375	7,400	10,000	12,500
Natick	28,830	33,500	37,500	40,000
Needham	25,795	32,500	36,000	40,000
Newton	92,385	98,500	110,500	125,000
Norfolk	3,470	5,500	7,500	10,000
Sherborn	1,805	3,800	5,500	8,000
Somerville	94,695	90,000	98,000	110,000
Waltham	55,415	61,500	66,500	70,000
Watertown	39,090	44,000	50,000	55,000
Wellesley	26,070	29,000	32,500	35,000
Weston	8,260	11,000	12,500	15,000
Westwood	10,355	14,000	17,500	20,000
Wrentham	6,685	10,000	18,000	25,000
	<u>1,404,300</u>	<u>1,494,900</u>	<u>1,649,100</u>	<u>1,808,500</u>

% increase over 1960

6%

17%

29%

\*U. S. Census, rounded to nearest "0" or "5".

APPENDIX E  
PRESENTATION  
by  
ELIOT CHILDS

5 March 1969

Coordinating Committee Meeting

## APPENDIX E

### UPPER CHARLES RIVER WATERSHED

#### HYDROLOGY

Elliot F. Childs  
Chief, Hydrologic Engineering Branch  
New England Division, Corps of Engineers

1. Introduction - This report is limited to two aspects of the hydrologic studies concerning the Charles River watershed upstream of the gaging station near Charles River Village in Needham. The two subjects are: (a) low flows and the storage required to produce yields of various dependabilities, and (b) an analysis of floodflows, their development and the effect of the extensive natural valley storage. This is a brief summary of the Corps of Engineers technical study on these two important items. A more complete analysis and results will be included in an appendix of the Charles River report.

2. Low Flow - The drought in the early 1960's resulted in the lowest sustained flows of record in the Charles River. The annual average discharges at Charles River Village were below normal from water years 1962 to 1967 with the lowest occurring in water year 1966 (a water year extends from 1 October to 30 September). The following table provides data on the runoff during these recent drought years.

<u>Water Year</u>	<u>Runoff in Inches*</u>	<u>Deficiency</u>	
		<u>Annual</u>	<u>Accumulated</u>
Average	25.3 (1937 to 1960)		
1962	23.2	2.1	2.1
1963	22.1	3.2	5.3
1964	18.8	6.5	11.8
1965	11.4	13.9	25.7
1966	9.0	16.3	42.0
1967	21.2	4.1	46.1
1968	24 <sup>†</sup>		

\* Depth of water in inches over the watershed of 184 square miles

3. Plate 1 shows the average monthly flows at the Charles River Village gage for the calendar years 1964, 1965 and 1966 as compared with the average monthly flows for the period of record. In normal years, the average flow during the 4-month period from July through October is about 130 cubic feet per second (cfs). In these three consecutive drought years the average flow for the same 4-month period dropped to 33 cfs in 1964, 25 cfs in 1965, and 34 in 1966. The lowest single monthly flow occurred in August 1965 with an average of 17.5 cfs. The lowest daily flow during these years was 7 cfs occurring on 24 August 1966.

4. It is interesting to note that based on past records the lowest average monthly flows of 116 cfs (0.63 cfs per square mile) are experienced in October. It is expected that the normal slow recession of flow during the summer months and extending into the fall is due to the ground water releases from the extensive natural storage areas in the watershed.

5. Storage-Yield-Dependability - The annual low flows at Charles River Village for duration varying from 1 to 180 days have been analyzed statistically by a computer program to determine their frequency of occurrence. The analysis was continued to determine the effect of various amounts of storage on the yield, or the low flow augmentation. Plate 2 shows graphically the relationship for the three variables: (a) storage in acre-feet per square mile, (b) yield in cubic feet per second per square mile, and (c) recurrence interval or frequency in years.

6. Although this relationship is basically applicable to storage and flows at Charles River Village, it is considered adequate for initial investigations and screening potential sites anywhere in the watershed. The yield at some proposed dam on an upstream tributary would probably be somewhat higher than indicated on plate 2, but it is believed the effect at Charles River Village will closely correspond to the results obtained from plate 2. The U. S. Geological Survey is presently making a comprehensive study of low flows and ground water supplies. Upon completion of this investigation it will be possible to estimate more accurately the storages required to produce dependable yields anywhere in the watershed.

7. Flood Studies - A hydrologic study has been made of flood development in the watershed. Although the basic data concerning floods is meager, the analysis is based principally on estimated peak discharges at numerous dams on the main river and the complete hydrograph of flows obtained from the records of the USGS gage at Charles River Village. Experience gained in analyzing floods in other New England river basins was essential in estimating the contributing flood hydrographs from the many ungaged tributaries. For flood studies, the river was divided into the following reaches:

<u>Limits of Reach</u>	<u>Distance</u> (miles)	<u>Drainage</u> <u>Area</u> (sq.mi.)	<u>Principal Tributaries</u>	
			<u>Name</u>	<u>Drainage</u> <u>Area</u> (sq.mi.)
Milford		7.8		
	5.2			
Box Pond Dam		14.2		
	5.6			
Caryville Dam		24.8		
	1.7		Hopping Brook	11.5
			Mine Brook	15.7
West Medway Dam		52.6		
	2.1		Chicken Brook	7.0
			Shepard's Brook	5.0
Medway Dam		65.0		
	19.8		Mill River	16.3
			Stop River	17.1
			Bogastow Brook	25.5
South Natick Dam		156		
			Fuller Brook	16.1
			Trout Brook	4.6
	6.8			
Charles River Village		184		

9. The August 1955 flood was selected for analysis. However, as the March 1968 flood hydrograph at Charles River Village was practically identical in magnitude and shape as the 1955, the analysis is considered applicable to both events. It is likely that all major floods in the watershed, including those experienced in March 1936 and July 1938, developed in the same general pattern.

10. Valley Storage - Flood hydrographs have been developed for the limits of each reach and for each tributary as designated in the preceding table. The total inflows to a reach have been summated and routed to obtain the outflow at the lower end of the reach. Plate 3 shows the reach extending from Medway Dam to the South Natick Dam, a distance of nearly 20 miles. This is the most important reach in the watershed with respect to its effect in modifying floods. The plate shows the large area inundated during the major floods and the profile of the high water elevations. Flood stages, between 7 and 8 feet above normal, result in about 3,200 acres of inundation. The storage in this area is estimated to be between 20,000 and 25,000 acre-feet, equivalent to about 3 inches of runoff from the watershed. Additional natural storage is taking place on the tributaries, particularly in the Great Black Swamp on Bogastow Brook.

11. Flood Routing - The inflow and outflow hydrographs for the August 1955 flood for this reach are shown on plate 4. The maximum flow at Medway Dam is estimated to be 3,800 cfs occurring about midnight on 20 August. The maximum total inflow, including Medway Dam and the cumulative discharges from the local tributaries, is at least 6,000 cfs. The extensive natural storage reduces and retards the outflow at the South Natick Dam to 3,100 cfs peaking late on the 23rd.

12. Peak Discharges - Plate 5 shows hydrographs of the 1955 flood at selected points on the main river. Maximum flows at these points with their respective drainage areas are as follows:

<u>Location</u>	<u>Drainage Area (sq.mi.)</u>	<u>Discharge (cfs)</u>	<u>Discharge (csm)*</u>
Milford	7.8	1,100	141
Bellingham	24.8	2,200	88.5
Medway	65.0	3,800	58.5
Natick (plate 4)	156	3,100	19.8
Charles River Village	184	3,220	17.5
Waltham (19 August)	251	2,490	9.9**
Waltham (23 August)	251	2,380	9.5**

\* Cubic feet per second per square mile  
 \*\* Affected by diversion at Mother Brook

13. The highest rate of discharge per square mile (csm) occurred at Milford with a peak of 141 csm. Similar high rates probably were experienced on upper tributaries before being modified by valley storage. The highest discharge on the main river occurred at Medway with an estimated peak of 3,800 cfs. The extensive valley storage below this point had a tremendous effect on the peak flow and at Charles River Village the maximum discharge was 3,220 cfs, equivalent to only 17.5 csm. The peak at Charles River Village came on the afternoon of 23 August, about  $4\frac{1}{2}$  days after the flood producing storm on 18 and 19 August.

14. The highest measured peak at Waltham occurred at Waltham on the 19th due to the removal of flashboards on the Moody Street Dam and the high local urban runoff. The crest of the floodflows from the upper watershed did not arrive in Waltham until 24 August. Of significant importance to the Charles River flows below Newton Upper Falls is the diversion of nearly 1,000 cfs through the Mother Brook Diversion.

15. The March 1968 flood was very similar to the August 1955 flood in magnitude. Peak flow at Charles River Village was the same for both floods with 3,220 cfs. The downstream flood crests in 1968 were slightly higher than 1955, due to channel improvement and less utilization of valley storage in the Needham-Dedham area. Peak flows of 2,410 cfs at Wellesley, 2,620 cfs at Waltham and 1,040 cfs at Mother Brook were measured at USGS gaging stations. It is interesting to note that peak discharges between 3,110 and 3,220 cfs have been experienced four times since 1936 at Charles River Village. Such consistent maximum flows are comparable with the regulated discharges from an ungated flood control dam.

16. Comparison with Blackstone River - Plates 6 and 7 show the comparison of discharges at Charles River Village with the adjacent Blackstone River as measured at a USGS gage at Northbridge, Massachusetts only 20 miles from the Village. Plate 6 shows the discharge profiles of the two rivers while plate 7 shows the 1955 flood hydrographs. The Blackstone River graphs illustrate the flood runoff characteristics of most of the inland New England rivers while the Charles River graphs vividly demonstrate the tremendous effect of the natural valley storage found on some of the coastal streams.

17. At Northbridge, 29 percent of the flood volume on the Blackstone ran off the first day with 30 percent on the second for a total of nearly 60 percent in two days. The entire flood had substantially passed in a week. At Charles River Village about 4 percent ran off the first day and 6 percent on the second for a total of 10 percent in two days. It took a week to pass 50 percent of the flood and approximately a month for the total runoff.

18. Conclusions - This study on droughts and floods has led to the following conclusions:

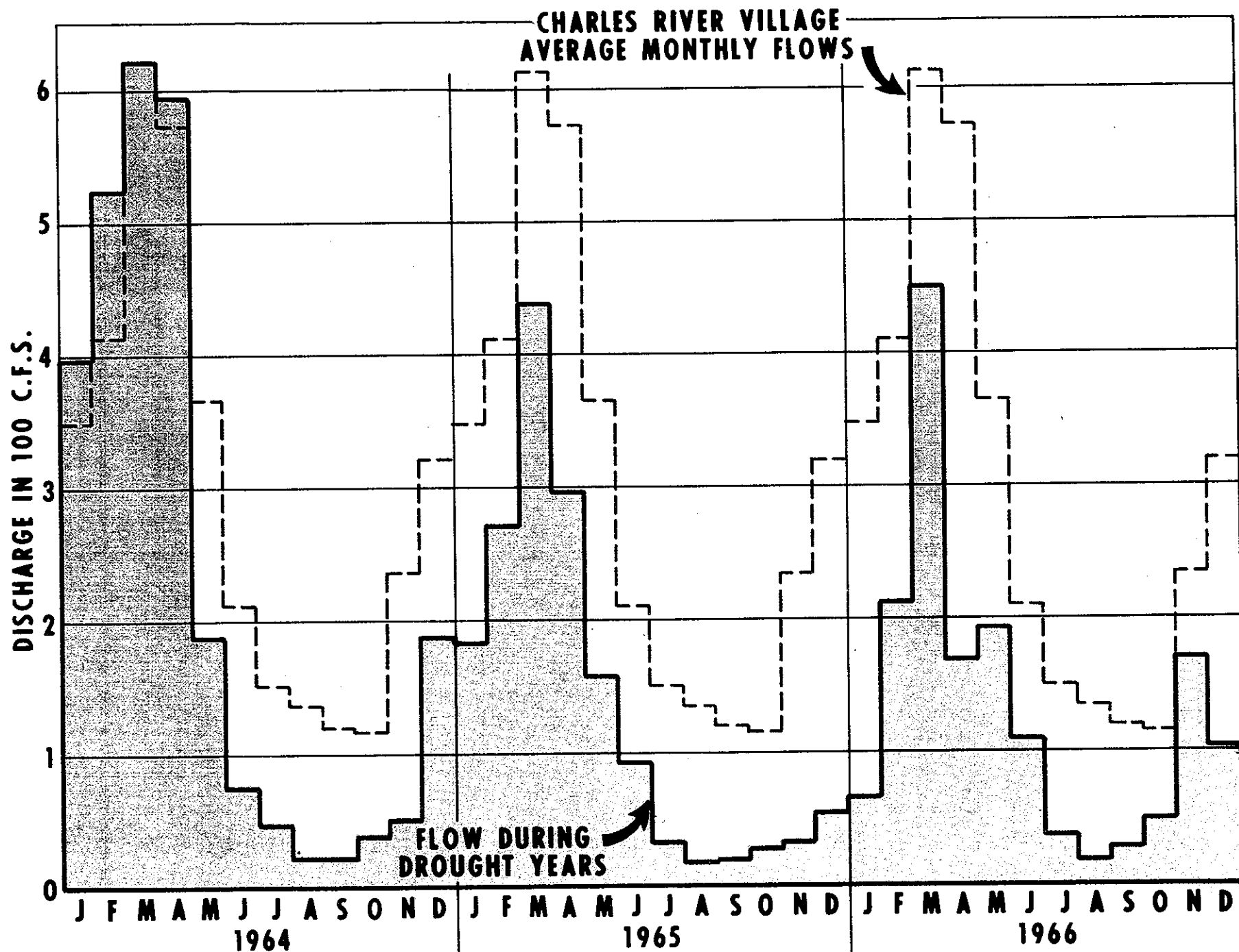
a. Storage to augment low flow and improve water quality and recreation is needed. A storage-yield-probability relationship has been derived to evaluate prospective storage sites.

b. The extensive natural storage in the watershed is very effective in controlling floods.

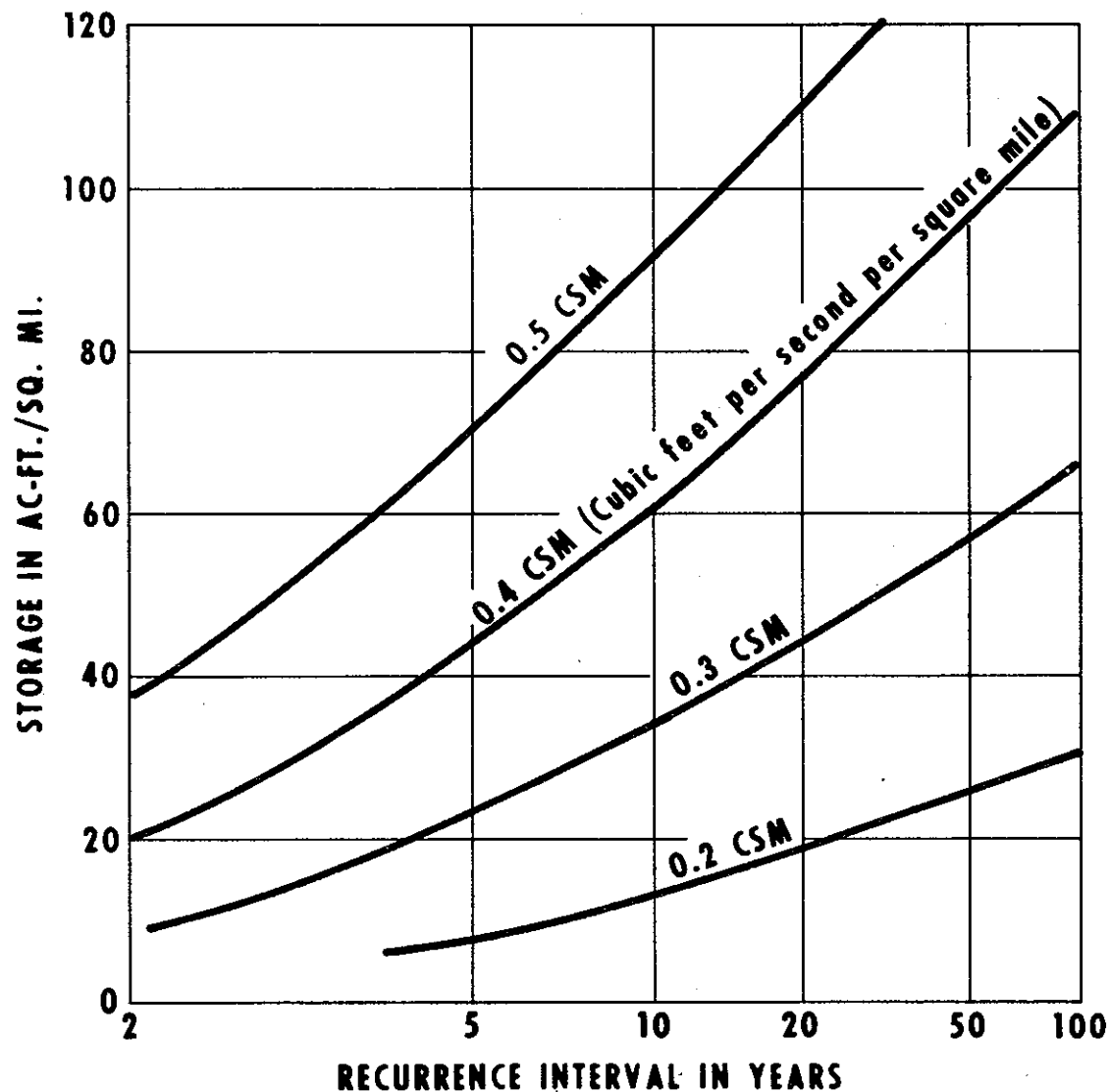
c. Loss of the natural storage by residential and commercial developments would result in larger floods. Appreciable reduction in the available storage could lead to channel "improvements" which would further accelerate runoff and increase the peak discharges.

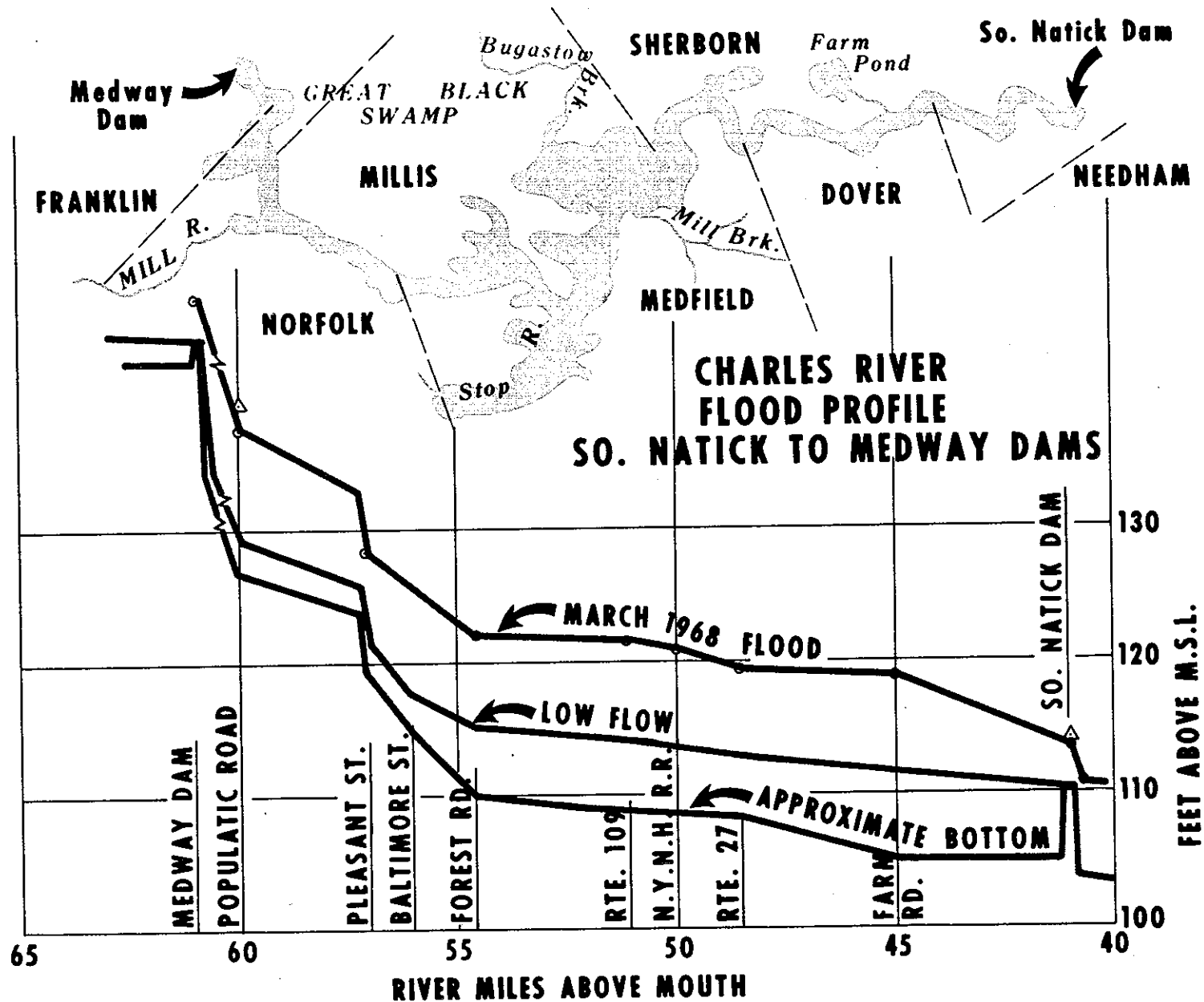
d. Single purpose flood control reservoirs are not justified. Some small flood control value might be realized by storage projects for low flow augmentation, but the discharge reductions and monetary benefits would be small.

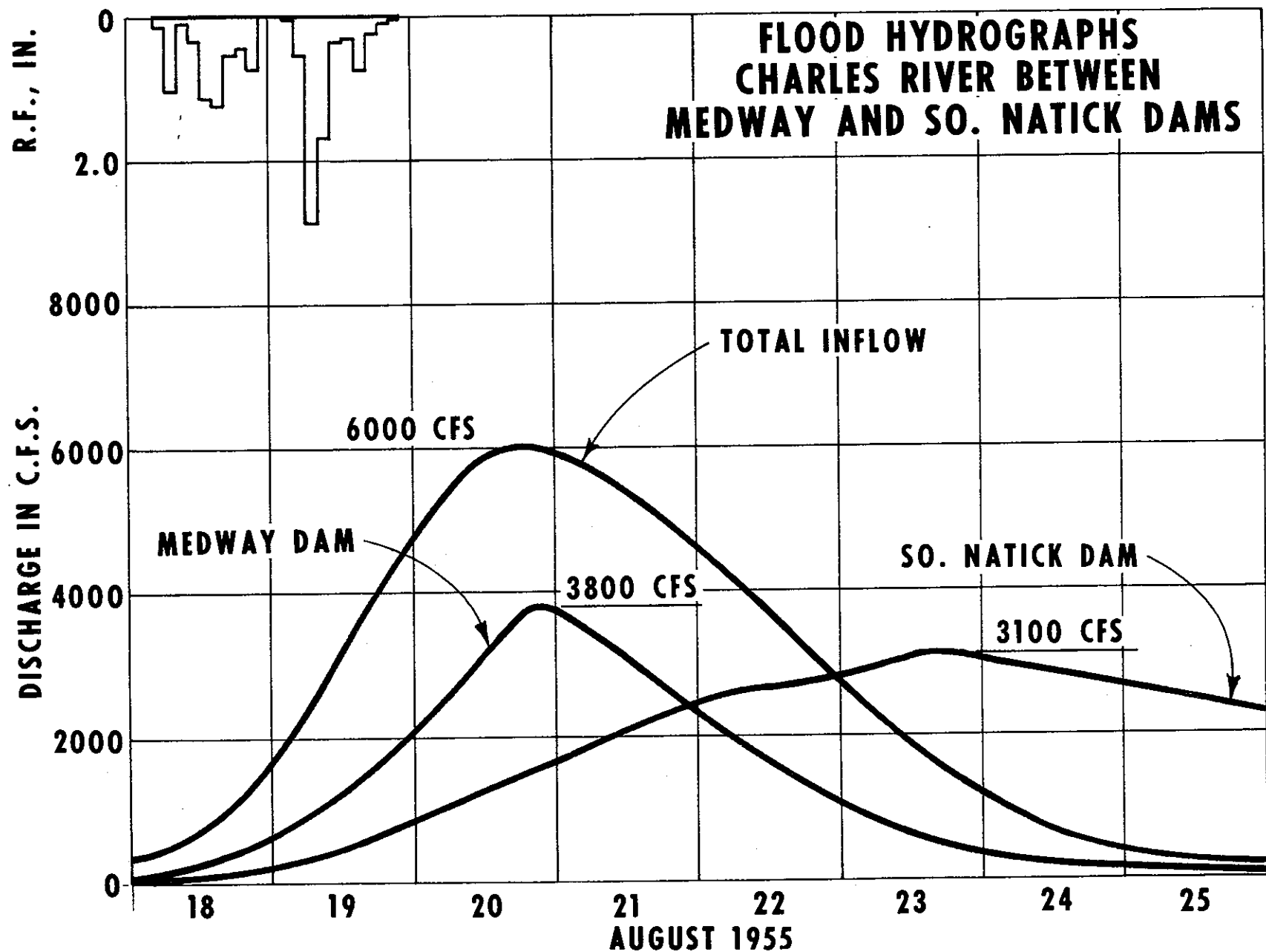
e. It is imperative to retain the present natural regimen and ecological conditions in the watershed. Serious consideration should be given immediately to preserving the swamps and marshlands that are so beneficial in controlling floods. The same areas are also of considerable value for fish, wildlife, and recreation. Acquisition or permanent easements of these lands for these multipurposes should be considered as an essential element in any watershed plan for the Charles River watershed.

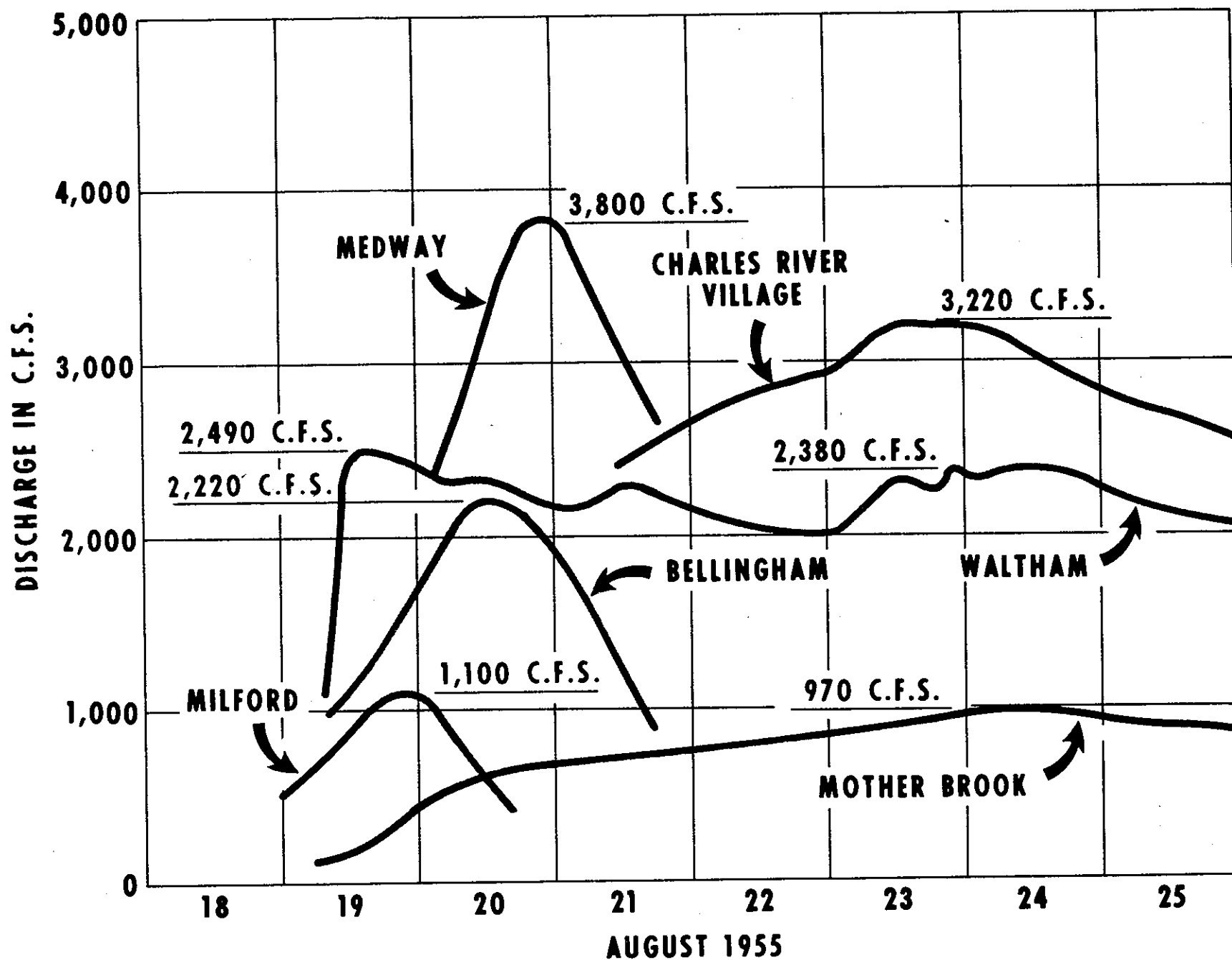


**CHARLES RIVER  
LOW FLOW STUDIES  
STORAGE - YIELD - FREQUENCY**

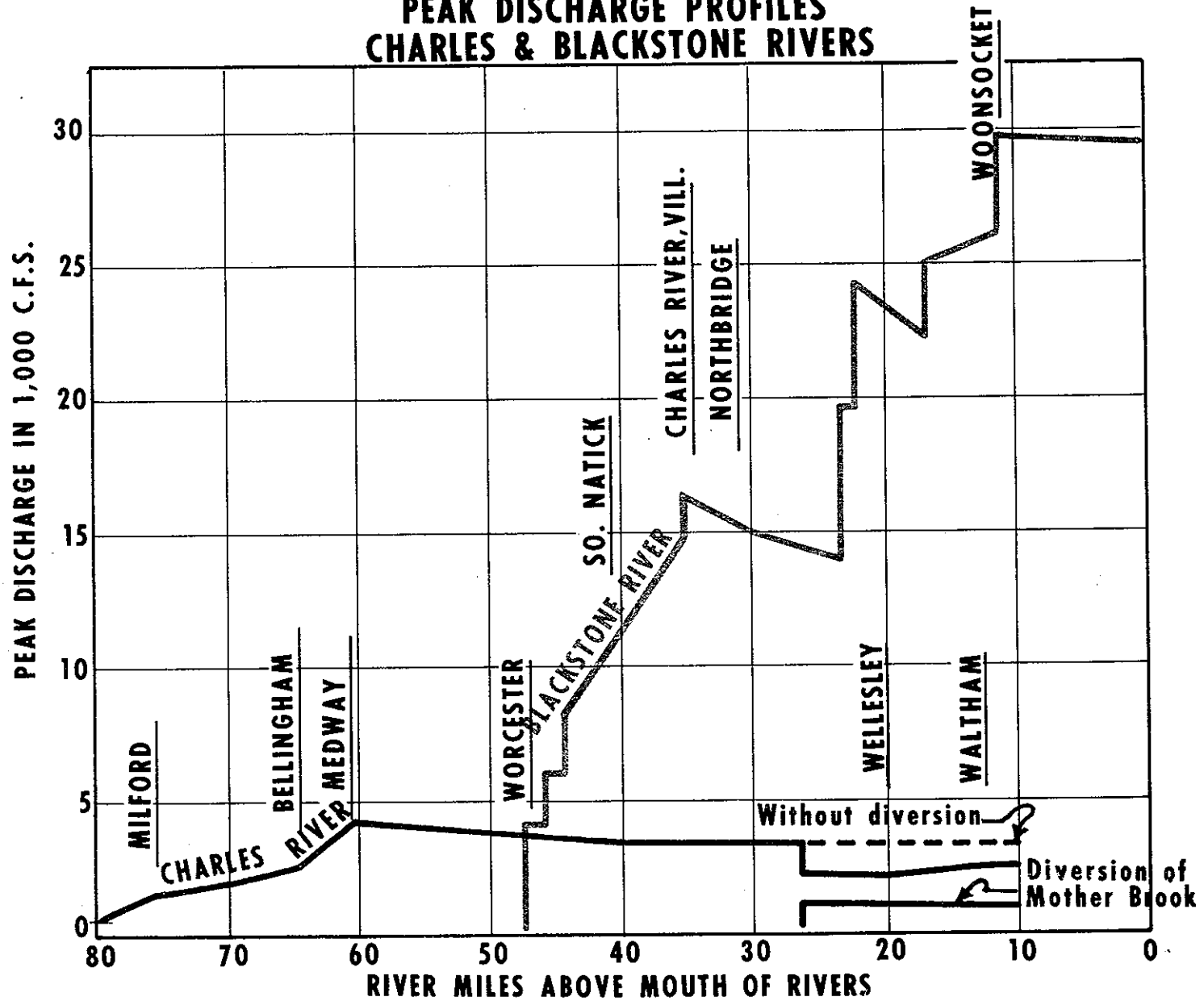


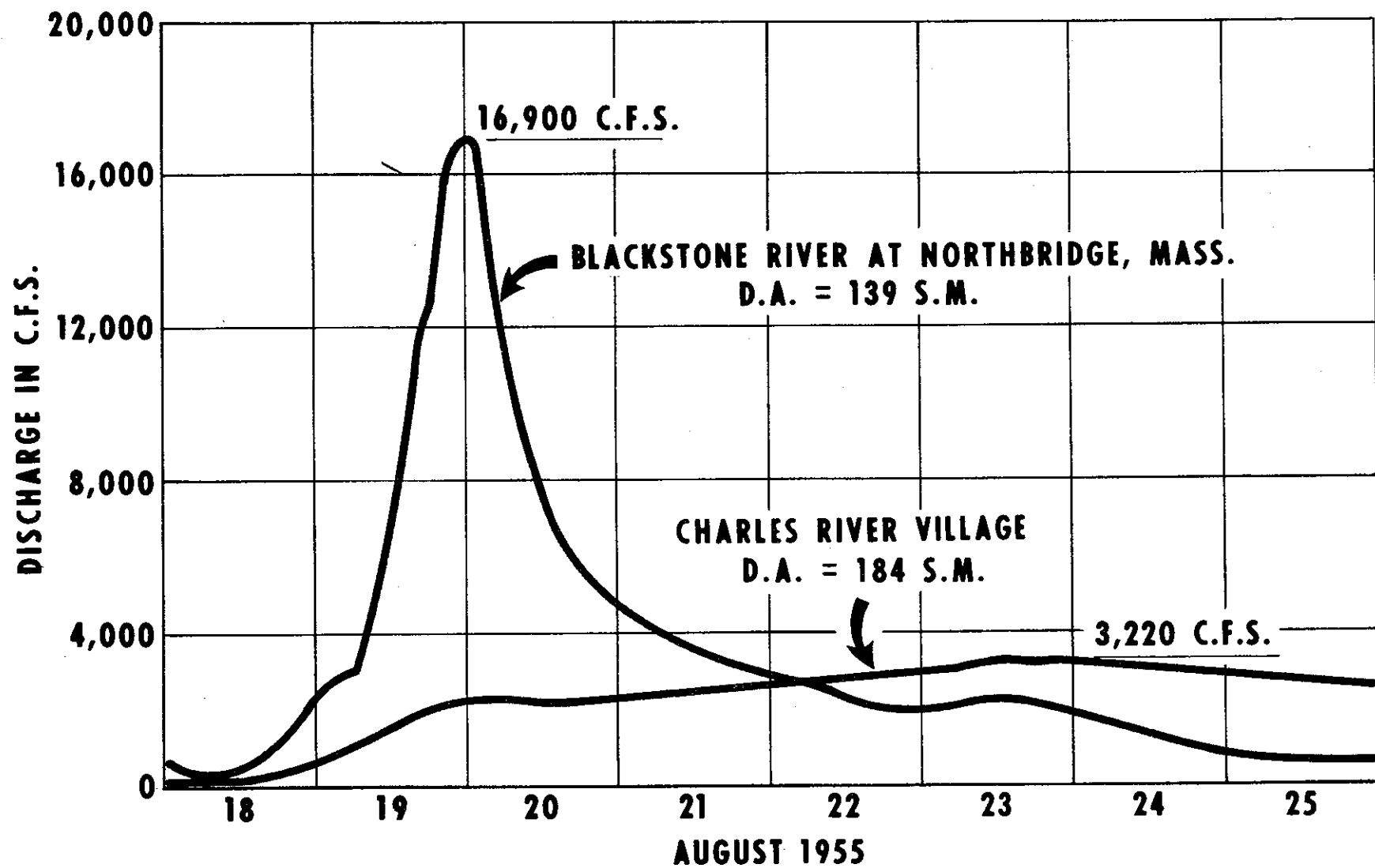






# PEAK DISCHARGE PROFILES CHARLES & BLACKSTONE RIVERS





APPENDIX F

REPORT

by

PAUL E. PRONOVOST

5 March 1969

Coordinating Committee Meeting

## CHARLES RIVER COORDINATING COMMITTEE

11 February 1969

## "NEWS" WATER SUPPLY STUDY

by

Paul E. Pronovost  
Corps of Engineers  
Department of the Army

I. INTRODUCTION

During the recent drought, Congress recognized the need for a much broader approach to water supply planning and development particularly if we are to meet future needs as relates to water supply. Accordingly, it authorized and directed the Corps of Engineers under Public Law 89-298 (27 October 1968) to conduct a water supply study referred to as the Northeastern United States Water Supply or "NEWS" Study. The area of this study includes all of the New England States, all of New Jersey, Delaware and the District of Columbia, and parts of New York, Pennsylvania, Maryland, Virginia and West Virginia.

The study is being chaired by the Division Engineer, North Atlantic Division with the Division Engineer, New England Division supporting and assisting him for the study area east of the Hudson-Champlain Drainage Basins.

Study activities have been utilizing, where possible, information already developed in local water supply studies, together with reconnaissance-type reports as already prepared by the New England Division for eight smaller regions. These latter efforts to be broadened in scope so as to explore the economies of scale, and the increased reliability that may accrue to water regionalization in consonance with the concept of the "NEWS" study authorization.

At present there are two major Feasibility Studies under way. One is investigating needs and proposing solutions and alternatives for the Northern New Jersey-New York City Metropolitan area. This Feasibility Study is being performed by a joint venture of Metcalf & Eddy - Hazen and Sawyer engineering firm.

The other Feasibility Study which began on 2 December 1968, is being performed by New England Division. It is this particular effort which my remarks will be concerned today.

## II PURPOSE OF FEASIBILITY STUDY

The "NEWS" Study is concerned with major areas of population within Southeastern New England, that have been identified as requiring early water supply augmentation to meet anticipated needs. From the Feasibility Study (which is not a survey report) there may likely evolve a series of survey reports similar to those as prepared by the Corps under its general survey program, the Charles River Interim Survey Report is a typical example.

The planning function will assume that there exists no political or social restraints. In this manner when constraints are introduced at later stages, it will be possible to measure their impact particularly on costs and upon solutions. The Feasibility Study therefore is intended to provide a technical approach to regional solutions and alternatives to water supply problems, those current and as projected through the year 2020. Material is to be developed in sufficient detail to permit the establishment of regional estimates of comparative costs of alternatives. The Study is scheduled for completion in 250 calendar days from the starting date of 2 December 1968.

### III. STUDY AREA

Defined broadly, the study area is dimensioned as follows: from the Springfield-Chicopee Metropolitan complex, east to the greater Boston area and including all coastal communities; north to the New Hampshire-Massachusetts border, and south to the Connecticut-Rhode Island border, including the State of Rhode Island. The State of Connecticut will be reviewed to the extent that the development of plans would have bearing upon their future potential sources.

### IV. CHARLES RIVER BASIN WATER SUPPLY NEEDS

The Charles River Basin lies entirely within the Feasibility Study area and thus its water supply needs will be considered under the "NEWS" effort. However, because of the large regional scope of the Feasibility Study area, it is impractical within the time frame to project community level water needs. The approach therefore will be on a sector level or groups of communities.

Thirty municipalities having nine percent or more by land area are located within the Charles River Basin. These 30 communities in 1965 housed approximately 28% of the total Feasibility Study area Massachusetts population of 4.7 million. It is apparent therefore that although the Charles Basin is small in relation to land area of the "NEWS" study, it is a major consideration for water demand.

Of the 30 communities mentioned previously, 11 are completely or partially served by the Metropolitan District Commission. The remaining 19 communities are serviced by private or municipally-owned water systems.

Based upon preliminary estimates, it appears that the Metropolitan District Commission current sources (using pre-drought yield of 330 mgd)

may be able to meet the demands of serviced communities to about the mid-1970's. In the Charles Study area, there are 19 non-MDC communities, of which 13 may not be able to meet projected 1975 water supply requirements from their own existing supply sources. Using these earlier estimates, it appears that water supply will be a major problem within the Charles Study area in the not too distant future.

The inputs which the "NEWS" Study will provide in meeting these water supply demands will be limited to regional scope solutions and alternatives. For example, such a regional solution might consist of investigating potential additional sources for the MDC such that future needs of that system can be met. Coordination on this important facet of the study is presently being maintained with officials of the MDC.

The potentials and economics of sub-regional sources will be evaluated by the Charles River Study unit utilizing generalized cost and yield estimates as provided by the "NEWS" Study unit.

The interplay of both studies therefore should complement the total effort toward meeting water supply demands within the basin.

This completes my prepared remarks Mr. Chairman. I would be happy to answer any questions. Thank you for your attention.

APPENDIX G  
PRESENTATION  
by  
ALFRED F. FERULLO

5 March 1969

Coordinating Committee Meeting

CHARLES RIVER STUDY  
COORDINATING COMMITTEE MEETING

5 MARCH 1969

STREAM CLASSIFICATION AND WATER QUALITY IMPROVEMENT

Alfred F. Ferullo  
Mass. Division of Water Pollution Control

On September 6, 1966, the Massachusetts Legislature enacted 4 bills which delineated the Massachusetts water pollution control program. Chapter 687 provided for a 150 million dollar state construction-grant program and a 1 million dollar-a-year research and development program, designed to develop new and improved waste treatment methods and to assist in the combined sewer discharge problem. Chapter 685 established the Division of Water Pollution Control under the Water Resources Commission in the Massachusetts Department of Natural Resources, with broad regulatory and administrative powers in the field of water pollution control. Chapters 700 and 701 provide for corporate and local tax incentive assistance to industries that install suitable industrial waste treatment facilities.

One of the responsibilities of the Division was to set water quality standards for the rivers and coastal waters of Massachusetts, to "protect the public health and enhance the quality of water". These standards were to be accompanied by a plan of implementation and enforcement.

In 1967 water quality standards were developed and all the waters of this state were classified according to anticipated use. A program has been set up by which polluters are notified that they are in violation of the standards and must meet a time schedule which culminates with final construction of treatment facilities. The standards and implementation program were approved by the Massachusetts Water Resources Commission and subsequently by the Secretary of the Interior. As a result, Massachusetts municipalities are eligible for maximum Federal grants.

A combination of State and Federal grants can contribute up to 80 percent of the cost of construction of a municipal plant.

If a municipality will construct and operate a plant for one or more industries, this facility will also be eligible for State and Federal grants.

The Charles River was classified as B and C for most of its length. Except for bacteria there is little difference between the various characteristics of these two categories. These classifications apply not to present but future water quality.

Figure 1 shows the classification of the Charles River Basin.

A short stretch in Hopkinton and Milford is class A. Cedar Swamp Pond is class B. The main stem of the Charles River is class C from Cedar Swamp Pond to Bridge Street in Dover. From Dover to Watertown Dam

the river is class B and down stream of Watertown Dan the river is class C.

Table 1 lists the various parameters for which limits have been established.

Class A waters have the highest quality and may be used as public water supplies with minimum treatment.

Class B waters are suitable for bathing and also water supplies after appropriate treatment.

Class C waters are suitable for boating and fish habitat and have good aesthetic characteristics.

The known polluters on the Charles River Basin are shown in Figure 2. Some of those listed have adequate facilities. Others are in various stages of their pollution abatement schedules.

Bettinger and Stylon discharge industrial wastes to Cedar Swamp Pond. New treatment facilities will be constructed by October 1969, for these industries.

Milford has a secondary trickling filter plant and chlorinates seasonally.

Unionville Woolen Mills has gone out of business.

Franklin will build a new plant. Because of the low dry weather flows in Mine Brook consideration is being given to locating the plant or the outfall closer to the Charles River.

Floral Development Corporation, Pope Industrial Park, Holliston. This plant discharges approximately 4000 gallons per day of wastes to Chicken Brook. They consist of dye, acids and ammonia. Subsurface disposal or equivalent secondary treatment is expected to be operational by December 1969.

Medway is scheduled to build a sewage treatment plant by April of 1972.

Your Laundry has the same pollution abatement schedule as Medway.

Buckley and Mann, Norfolk. Wastes from this textile company consist of waste fiber, dyes, acid and dirt. These are treated in two lagoons which discharge into Mill Brook.

A new plant is completed at the Wrentham State School and will be in operation in the very near future.

Pondville Sanitorium. Wastes from this institution are discharged to Stop River after settling, sand filtration and seasonal chlorination.

A new plant for Norfolk and Walpole Prisons is in the design stage.

The Ruberoid Company and Cliquot Club discharge their industrial wastes to a small brook that flows by the Millis Sewage Treatment Plant. Ruberoid will install a treatment facility by October 1969. The schedule for Cliquot Club calls for pollution abatement by April of 1972.

Medfield. The Medfield Sewage Treatment Plant receives wastewater from about a thousand persons. Treatment consists of primary settling and sand filtration. Seasonal chlorination will commence in the Spring of 1969.

Medfield State Hospital. This institution treats its wastes with primary settling tanks and sand filters. Chlorination is seasonal.

St. Stevens School, Sherborn. This is a small source. Wastes are treated by septic tanks and sand filters.

Tillotson Rubber Company has diverted its wastes from Rosemary Brook to the MDC Sewer.

Pierce Brothers Oil Company which processes waste oil is seeking new methods of disposing of its wastes.

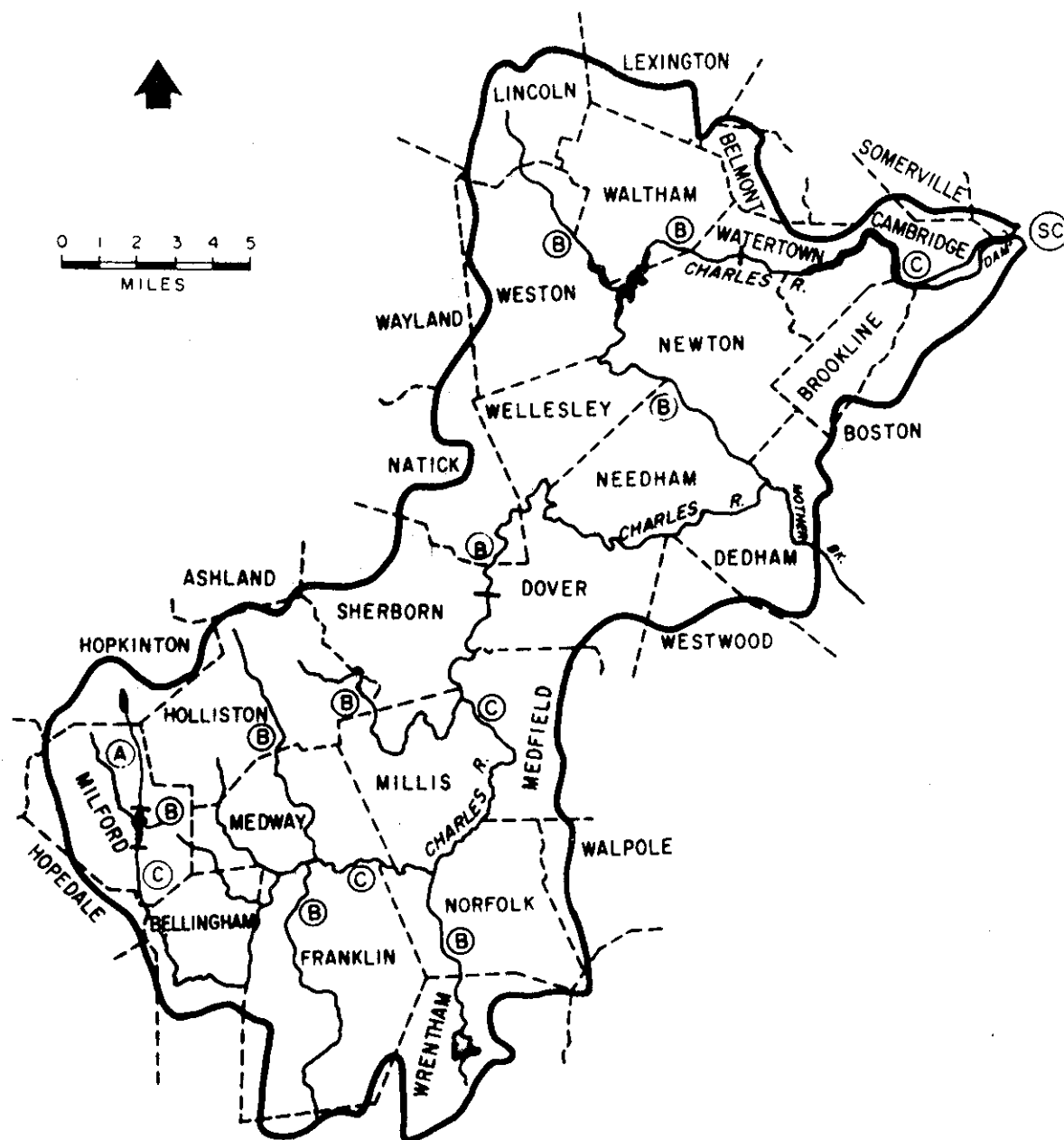
Penn Central Railroad near Boston University Bridge will install oil removal equipment to prevent oil pollution in the lower Charles River.

With the construction of new wastewater treatment plants, water quality upstream of Watertown Dam is expected to improve in the next few years.

Pollution in the Charles River downstream of Watertown Dam is caused primarily by combined sewer overflows and is complicated by the presence of salt water. It is hoped that water quality in this stretch of the

river, however, will be upgraded substantially with the completion of the combined sewer detention and chlorination facility and the construction of the new locks downstream of the Charles River Dam.

We are shooting for a high degree of treatment for each of the facilities discharging into the Charles River. Because of the great influence of algae to dissolved oxygen and nuisance conditions, it may be necessary in the future to require nutrient removal as well. Conventional treatment removes little of these. (Figures 3 and 4 show the effect of algae on dissolved oxygen.) Nutrient removal is expensive and must be balanced against such alternatives as low flow augmentation and discharge to the MDC sewerage system. These alternatives are being examined by the Corps of Engineers and the Federal Water Pollution Control Administration.



COMMONWEALTH OF MASSACHUSETTS  
 WATER RESOURCES COMMISSION  
CHARLES RIVER BASIN  
 CLASSIFICATION

WATER USE CLASSES - (A) (B) (C) (D) (SB)  
 — CHANGE CLASSIFICATION

Figure 1

# CHARLES RIVER WATERSHED

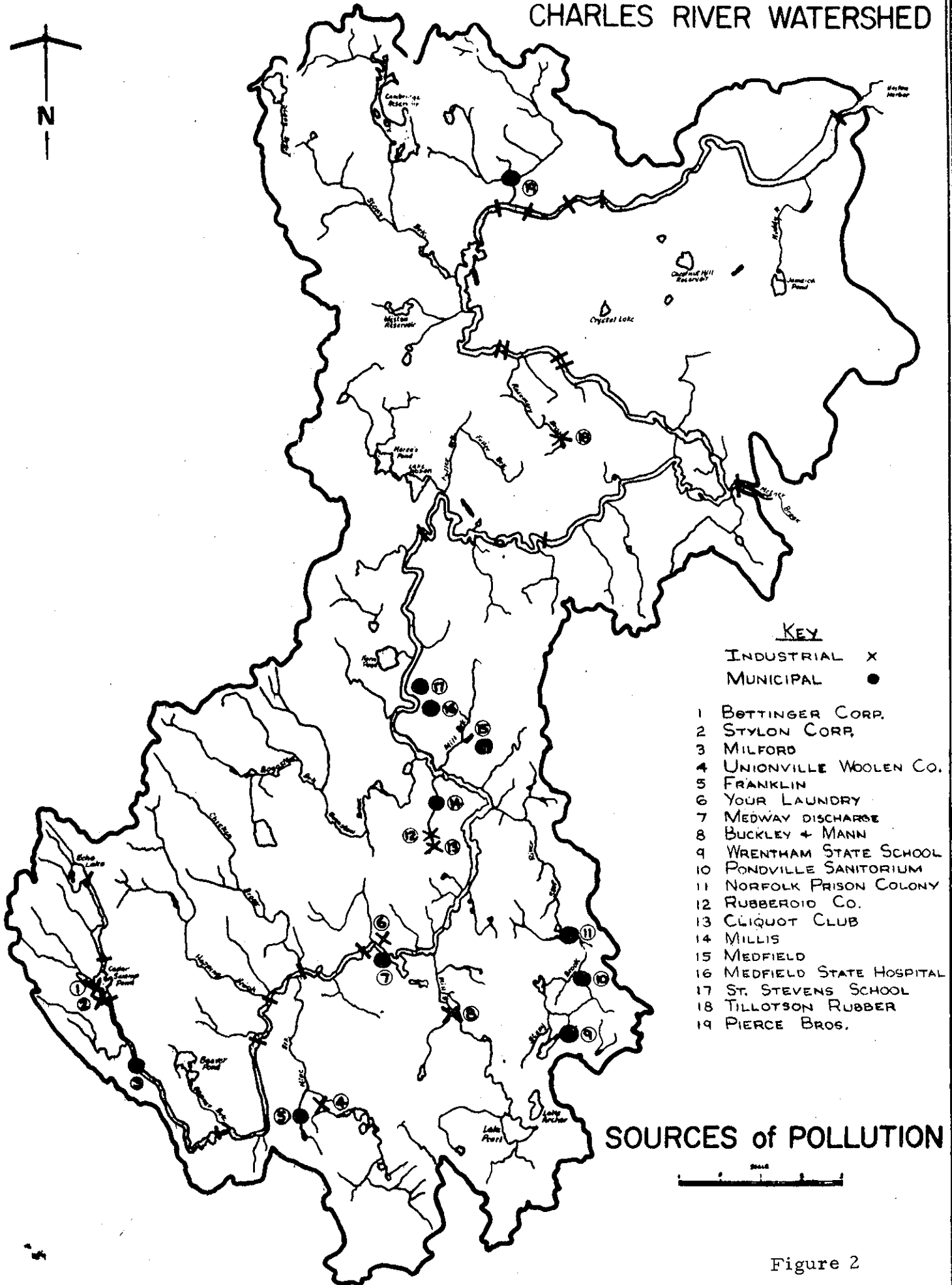


Figure 2

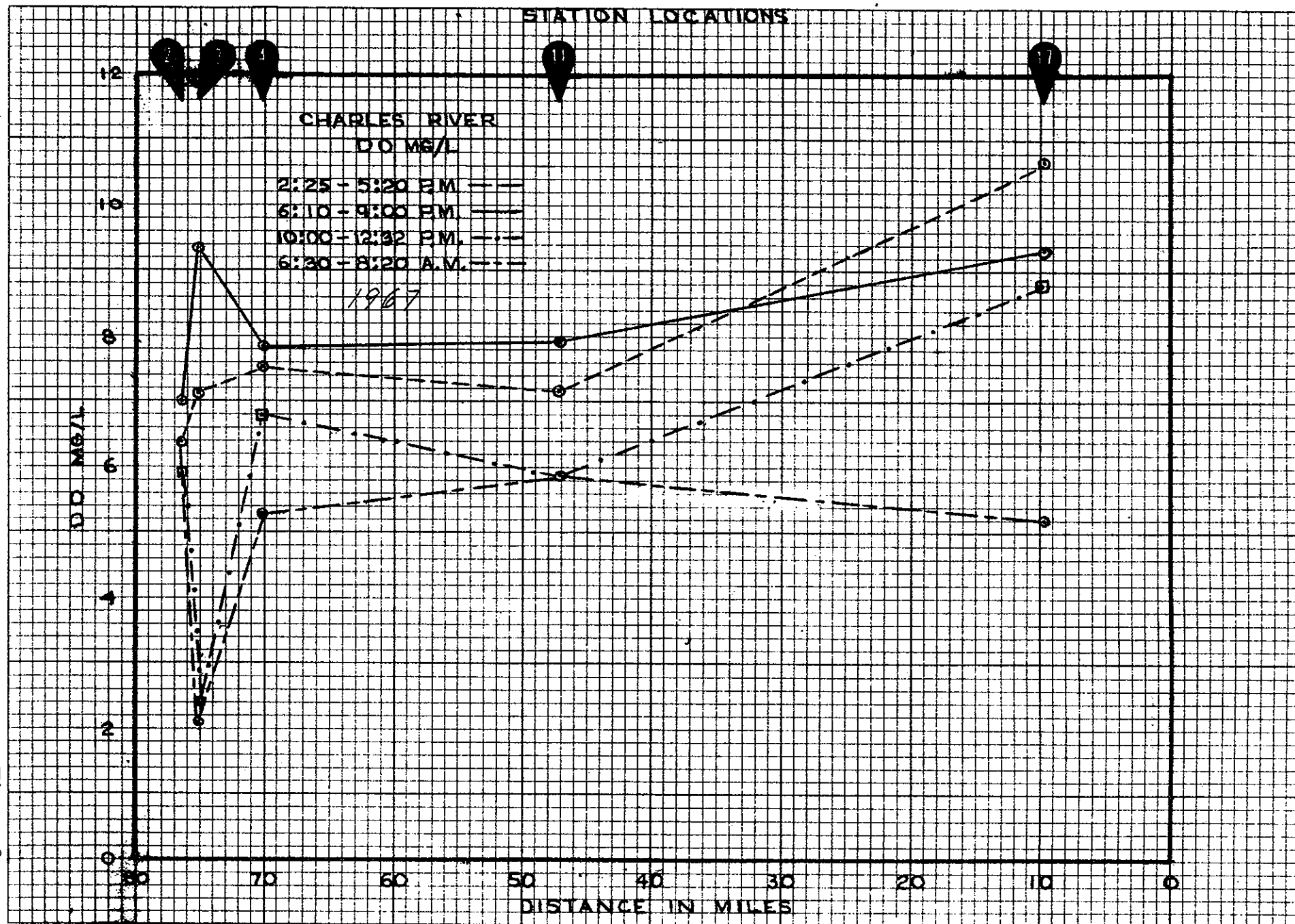


Figure 3

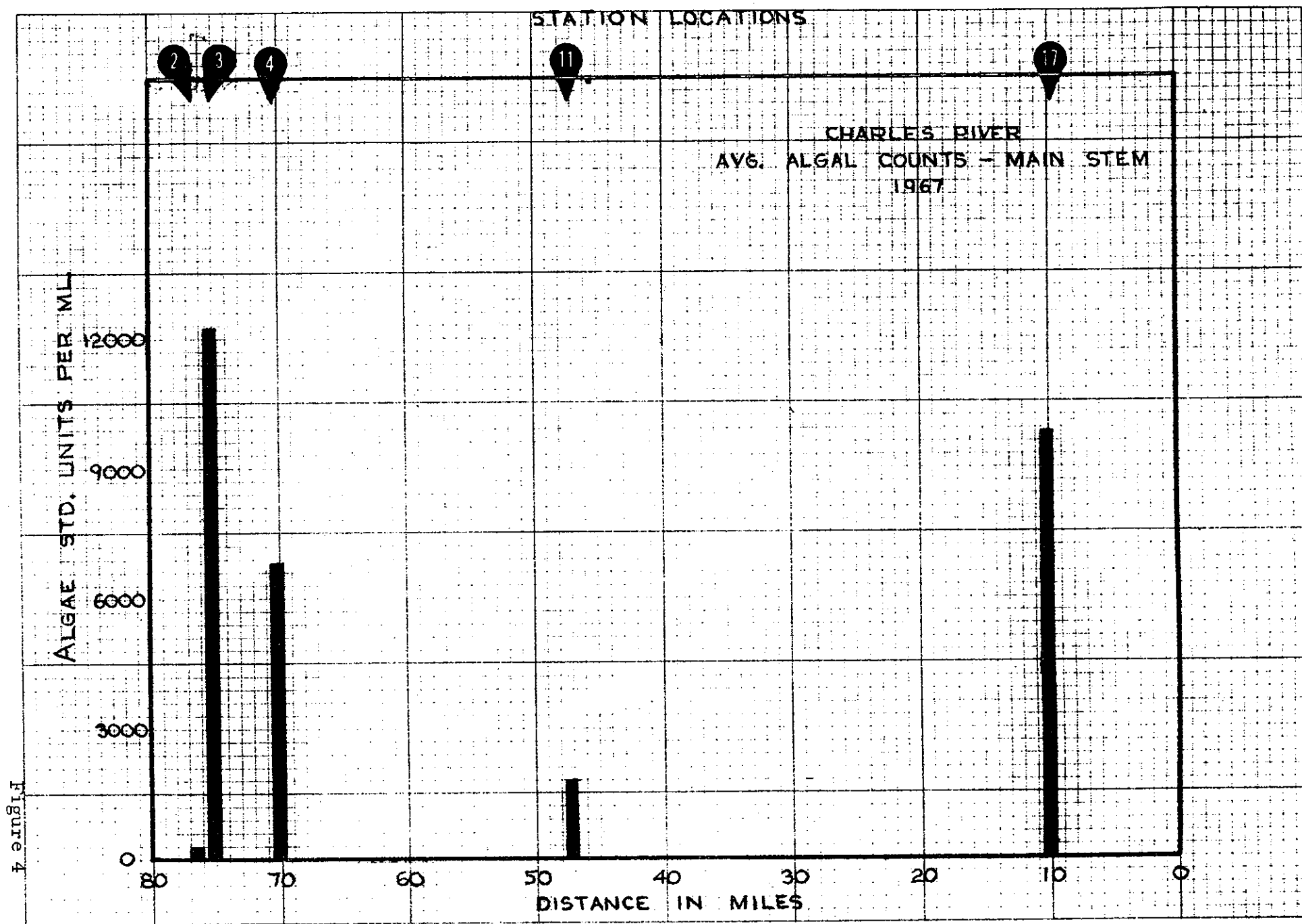


Figure 4

TABLE 1  
SUMMARY OF WATER QUALITY STANDARDS

ITEM	INLAND WATERS				COASTAL WATERS		
	CLASS A	CLASS B	CLASS C	CLASS D	CLASS SA	CLASS SB	CLASS SC
DISSOLVED OXYGEN							
Minimum, mg/l	5.0	5.0	3.0 (2)	2.0	6.5	5.0	3.0 (2)
Percent Saturation (1)	75	75	-	-	-	-	-
COLIFORM BACTERIA							
Average value per 100 ml	50	1000	NONE (3)	NONE (3)	70	700	NONE (3)
pH (Min - Max)	(4)	6.5-8.0	6.0-8.5	6.0-9.0	6.8-8.5	6.8-8.5	6.5-8.5
TEMPERATURE, Deg. F							
Cold water fishery	(4)	68	68	-	-	-	-
Warm water fishery	(4)	83	83	90	-	-	-
Maximum increase	(4)	4	4	-	-	-	-
TOTAL PHOSPHATE, mg/l	-	0.05	0.05	-	0.07	0.07	0.07
AMMONIA, mg/l as N	-	0.5	1.0	-	0.2	0.2	1.0
PHENOLS, mg/l	-	0.001	0.002	-	-	-	-

- (1) During 16 hours of a 24 hr period.
- (2) Minimum of 5.0 mg/l during 16 hours of a 24 hr period.
- (3) None in such concentrations that would impair uses assigned this class.
- (4) As naturally occurs.

NOTE: The remaining criteria (solids, color and turbidity, taste and odor, chemical constituents and radioactivity) have not been assigned limiting values. Allowable concentrations depend on most sensitive water use. The complete Water Quality Standards have been published and are available from the Division of Water Pollution Control, 100 Cambridge Street, Boston, Massachusetts.

APPENDIX H  
PRESENTATION  
by  
WILLIAM BUTLER

5 March 1969

Coordinating Committee Meeting

CHARLES RIVER STUDY

## COORDINATING COMMITTEE MEETING

5 March 1969

## POLLUTION &amp; SEWERAGE - TREATMENT STUDIES

by

William J. Butler

Federal Water Pollution Control Administration

Since the last Coordinating Committee Meeting, we have established a mathematical model of the Upper and Middle Charles River which indicates the river's dissolved oxygen response to variations in waste loadings and quantities of streamflow. As stated at the last meeting, this model will be the basis for determining future requirements for flow augmentation or other pollution control measures.

At the present time, I cannot present any specific recommendations for future flow augmentation or other measures for the entire river. However, we have analyzed in some detail future flow requirements and degree of waste treatment relationships for the headwaters of the Charles and the Milford municipal waste treatment facility. I plan to present some of these results, which will point out the methodology we will use in analyzing the entire river.

First of all, estimates of the future population of each community and the future population served by the sewerage system in each of the Upper Charles communities are shown on Plate 1. As you can see, by 2020 the population of the Upper Charles River communities will increase substantially. The Milford sewerage system serves approximately 12,000 persons at the present time. By 2020, the projected figure will be 36,000 persons.

Plate 2 shows the sewage flows contributed by the communities for the projected years. By 2020 the total sewage flow from these towns is expected to be about 70 cfs as compared to 7.5 cfs in 1965. The quantity of sewage contributed by Milford in 1965 was 2.4 cfs and by 2020 is expected to increase to 9.0 cfs.

From these graphs it is obvious that in the future a higher degree of treatment than secondary treatment, that which removes about 85%

of the deoxygenating wastes will be necessary to meet water quality standards. And because of the large volumes of waste flow in relation to the summer low flows (between 12 and 20 cfs at the Charles River Village gage), in future years municipalities will be required to aerate their effluents to provide adequate dissolved oxygen concentrations before discharge to the river.

In our analyses of the flow requirements at the headwaters of the Charles River, we have assumed that by 1980, Milford will be required, as a minimum, to provide a type of treatment known as coagulation and sedimentation in addition to secondary treatment during the critical summer months. This treatment removes about 90% of the deoxygenating wastes and also about 90% of the total phosphate, which is one of the nutrients necessary in algal production. When phosphate concentrations are excessive nuisance algal blooms may result.

With no additional treatment above sedimentation and coagulation in 2020, approximately 45 cfs of dilution water will be required during the critical months of July and August to maintain dissolved oxygen standards. And conversely with no flow augmentation, to meet desired levels of water quality in 2020 approximately 98% of the deoxygenating wastes with aeration to 6 mg/l will be necessary at an annual cost above the minimum required treatment of \$109,000 per year over fifty years. The following view graph (Plate 3) shows the variation in cost of additional treatment versus dilution flow provided. As more dilution is provided, the cost of treatment decreases.

With a knowledge of augmentation flows needed for different levels of treatment, the volume of storage required to meet these needs can be computed. We will then ask the Corps or other interested agencies to furnish us the average annual costs of providing various volumes of storage whether the storage be supplied from within the watershed or be obtained from another watershed. By plotting costs of storage and costs of treatment per level of storage, we can determine the least cost combination. Plate 4 will serve as an example. The curves which were developed for a stream other than the Charles River are plots of the average annual cost of treatment needed at different levels of storage and the average annual costs of storage. By summing the treatment costs and storage costs, a curve is established that will give the combined average annual cost of treatment and storage. There is an optimum combination of storage plus treatment, the minimum point on the curve. The storage at the optimum point would be the recommended storage from strictly a dollar cost point of view. Of course in the plan formulation further evaluations will have to be made of the social or intangible costs - the gains and losses associated with alternative combinations of treatment and storage including those associated with specific storage sites.

This is the type of analyses that we will be performing on the entire Charles. Any flow provided at Milford may benefit other reaches of the stream, and therefore, the costs of treatment of waste from other municipalities will have to be added to the cost of treating Milford's wastes.

Another alternative we will investigate is the feasibility of transporting a portion of or all wastes to the MDC system. The cost of transferring wastes out of the watershed will be compared with the cost of the optimum combination of treatment and storage.

In conclusion, I feel that by June of 1969, we can come up with some firm recommendations of storage requirements.

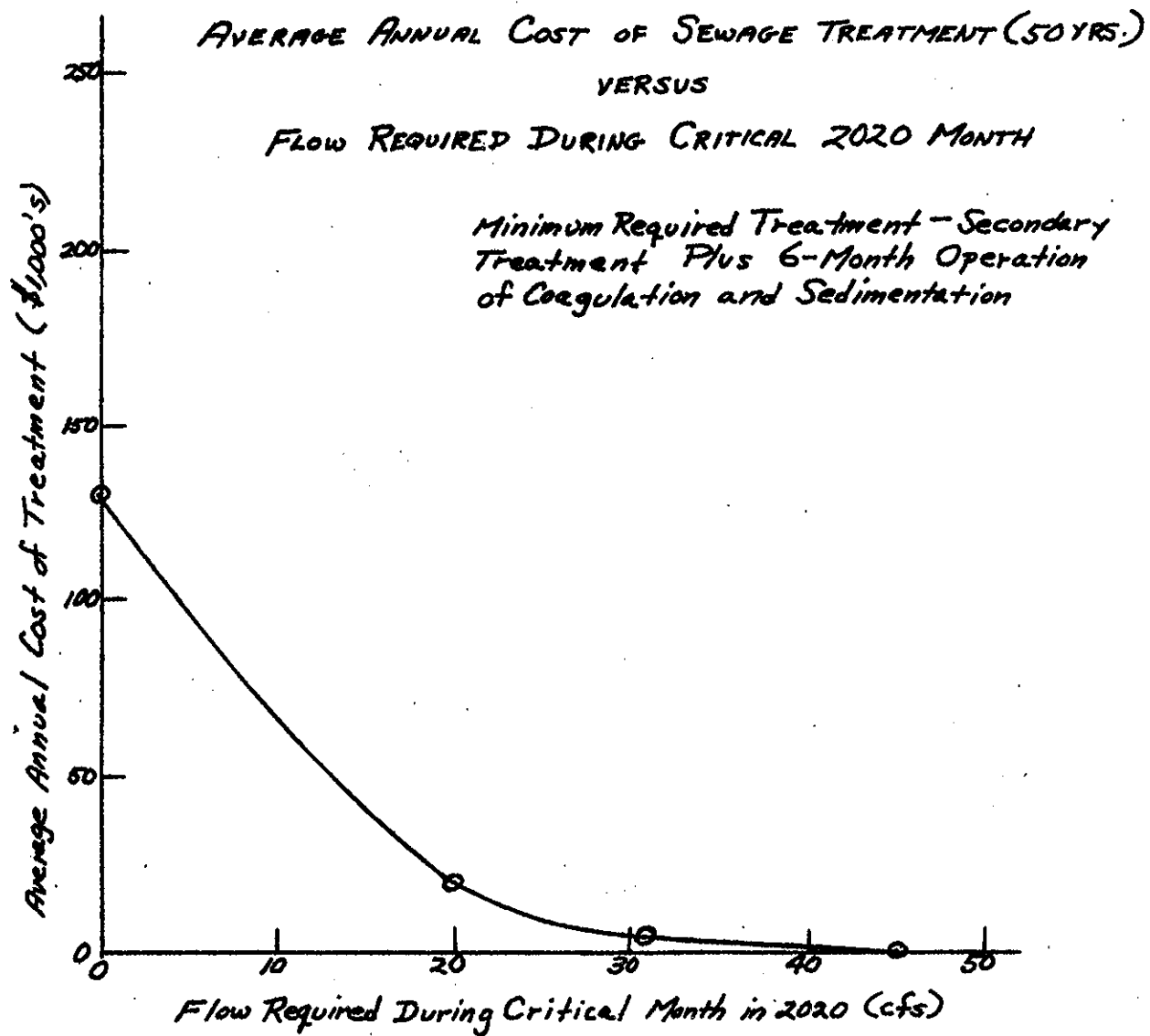
PROJECTED POPULATION  
OF UPPER CHARLES RIVER WATERSHED COMMUNITIES

Community	1965		1980		2000		2020	
	Pop.	Pop.Served	Pop.	Pop.Served	Pop.	Pop.Served	Pop.	Pop.Served
Bellingham (50%)	5,300	0	9,000	2,700	14,000	7,000	18,500	13,000
Dover	3,600	0	6,500	0	11,500	3,400	17,500	7,000
Franklin	14,700	4,500	22,000	8,800	41,000	20,500	60,000	48,000
Holliston	8,900	0	15,000	4,500	24,000	9,600	35,000	21,000
Medfield	7,500	1,000	12,000	3,600	28,000	19,600	38,000	34,200
Medway	6,900	200	10,000	3,000	15,000	6,000	19,000	11,400
Milford	17,000	12,000	22,000	17,600	29,000	26,000	36,000	36,000
Millis	5,300	1,000	9,000	2,700	18,000	9,000	26,000	20,800
Norfolk	4,000	0	7,000	700	13,000	3,900	22,500	11,200
Sherborn	2,300	0	7,000	0	19,000	7,600	32,000	22,400
Wrentham	7,500	0	13,000	2,600	36,000	21,600	48,000	38,400
Total	83,000	18,700 (22%)	132,500	46,200 (35%)	248,500	134,200 (54%)	352,500	263,400 (75%)

PLATE 1

PROJECTED WASTE FLOWS  
OF UPPER CHARLES RIVER WATERSHED COMMUNITIES

Community	Location of Waste Discharge (River Mile)	1965 Waste Flow (cfs)	1980 Waste Flow (cfs)	2000 Waste Flow (cfs)	2020 Waste Flow (cfs)
Milford	73.4	2.4	3.1	5.6	9.0
Bellingham	69.1	0.0	0.4	1.4	3.0
Franklin	63.2-3.4	2.2	3.1	7.0	14.7
Medway	58.7	0.3	0.4	1.2	2.5
Wrentham	59.6-3.4	0.0	0.6	5.6	11.6
Norfolk	51.8-3.4	1.1	1.2	2.0	4.1
Millis	49.8-1.1	1.0	1.2	2.8	6.2
Medfield	49.2-1.9	0.5	1.0	4.6	8.8
Holliston	48.4-6.0	0.0	0.8	1.8	4.6
Sherborn	47.0-2.5	0.0	0.0	1.7	6.0
Total		7.5	11.8	33.7	70.5



**PLATE 3**

